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Mapping of the Global Productivity on COVID-19 since the Origin of the Pandemic

Dr.R. Santhakumar
University of Madras, Chennai, santham74@gmail.com

Dr.K. Kaliyaperumal
University of Madras, Chennai, kkperumal3@gmail.com

Dr.P. Balasubramanian
Manonmaniam Sundaranar University, India, bala_phd2010@yahoo.com

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Dr. R. Santhakumar*
Technical Associate, Madras University Library, University of Madras
Chennai - 600 005, Tamil Nadu, India
Email id: santham74@gmail.com
Cell No. 09941421050

Dr. K. Kaliyaperumal**
University Librarian, University of Madras, Chennai - 600 005
Tamil Nadu, India
Email id: kkperumal3@gmail.com
Ph No. 044-25399476

Dr.P.Balasubramanian***
University Librarian, Manonmaniam Sundaranar University
Abishekapatti, Tirunelveli-627012, Tamil Nadu, India
E.mail id: bala_phd2010@yahoo.com
Ph No. 09443519517

Abstract

The novel corona virus disease (COVID-19) is one of the most infectious diseases that primarily affect the lungs, which inflicted huge losses to the human beings of the globe. As its spread savagely, the literature of is also proliferated within a few months. It is the prime duty of this study to map the different aspects of this scientific literature by applying scientometrics techniques. The data related to this study are recorded in the Web of Science core collection, since the origin of the dreadful virus to January 2, 2021. Thus, 55049 articles have been published on COVID-19 in 22518 journals, originating from 194 countries. Networks of contributing authors, institutions, countries and source titles were visualized in maps using VOS viewer software, which highlight discrete developments in research collaborations. Wang Y from the Guangzhou University of Chinese Medicine, China is the leading author in the field with 220 (0.40%) articles. The United States of America (USA) is the leading country with (29.92%) in terms of research productivity. In addition to this, over 35015 institutions contributed in corona virus research, and Hardvard University, USA (68) has recorded highest h-index. The study showed a positive correlation between the grants awarded to the research laboratories and their research productivity. The paper provides quantitative analysis on the leading institutions and individual researchers who are significantly contributing to the COVID-19 research productivity at the global level.

Keywords: Research productivity - COVID-19, High Productivity Subject Areas – COVID19 Global Research Performance, Network Analysis – COVID Literature

1 Introduction

At the end of 2019, the novel corona virus which is popularly known as COVID-19 (a shortening of Corona Virus Disease-19) was found out in Wuhan City, Hubei Province, China and instantly spread around the world. On 30th January 2020, World Health Organization (WHO) officially declared that the COVID-19 epidemic is a serious public health issues and the nations must be very careful. Which resulted in global shout down. It is highly transmittable, pathogenic viral infection results in a large-scale epidemic to the modern society of the twenty-first century.

As of 2nd January 2021, the number of cases of confirmed COVID-19 globally is over 95 million affecting virtually every country and over 2 million people have died so far globally. Though the novel corona virus pandemic have put a halt to many economic and socio cultural activities but it has triggered an avalanche of scientific research, both within and outside the medical domain. In an effort to address this challenge and to help better organize these emerging and rapidly developing scientific output, it is essential to study the proliferation of emerging scientific knowledge on COVID-19 to inform further research as well as evidence based policy making.

Scientometric applications are widely used for mapping knowledge in different scientific subjects. Over the years, scientometric studies have been used for analyzing the subject emerging in the global knowledge landscape and evaluating the evolution of research over a time. With a growing interest in COVID-19 related research around the world, this scientometric study may inform the current status of global research and provide meaningful insights on further research. There is countable number of scientometric analysis on COVID-19 literature available so far that specifically focuses on contemporary scientific development on COVID-19. This study is also aimed to address this knowledge gap and conducted a scientometric analysis to evaluate the characteristics of the current topic of scientific literature on COVID-19, identify the prolific authors, institutions, countries and source titles involved.

Review of Literature

Few studies have been undertaken in the past on scientometrics analyses of COVID-19 research output which are reviewed hereunder:

Nadja Grammes showed that 2551 scientific literature about the Corona virus was indexed in Web of Science. The top 3 countries involved in COVID-19 research were the United States, China, and Italy. The United States was most active in terms of collaborative efforts, sharing a significant amount of manuscript authorships with the United Kingdom, China, and Italy.

Sahoo and Pandey attempted to evaluating the growth of scientific literature in the domain of corona virus and Covid-19 pandemic research based on scientometric indicators: prolific countries and relative citation impact (RCI); influential institutions; author analysis and network, h-index and citation.

Zyoud et al studied COVID-19 pandemic were retrieved from Web of Science and analyzed using the web application, allowing for large data scientometric analyses of the global geographical distribution of scientific output. The study found that USA published the largest number of publications on COVID-19 (4479; 23.4%), followed by China (3310; 17.4%), Italy, (2314; 12.2%), and the UK (1981; 10.4%). British Medical Journal was the most productive.

Engin Senel and Fatih Topal analysed the corona virus disease study was Web of Science Collection database. All items published between 1980 and 2019 The United States, China, Germany, the United Kingdom, and Netherlands were the most productive countries. Publications in corona virus literature have been produced from almost every country in the world, except for some countries in Asia and Africa.

Among these literature, this study covers the research output since the eruption of the pandemic.

3 Objectives of the study

The objectives of the studies focus on the following aspects:

- Forms of Publications
- Most prolific authors
- Highly productive institutions
- Highly preferred journals
- Subject wise distribution of publication output

4 Materials and Methods

Bibliographic details of the scientific literature on COVID-19 were retrieved from web of science database; it is a major source for bibliometrics, citations, and other academic impact information of scientific publications on various branches of science and technology. The searches for establishing the datasets used in the article were last updated on 02.01.2021. To obtain the reference database for corona viruses the title and abstract of the scientific publications were searched for the terms was used in topic search to identify and retrieve the COVID-19 literature. Considering the time span of the outbreak in late 2019, the search strategy was limited to 2019-2020 to retrieve data that may contain records on COVID-19. The bibliographic details of the reference databases, 55082 articles associated with COVID-19, including the list of authors, year of publications, source title, author affiliations, abstract, subject areas and list of references were exported and analysed using scientometric methods. Apart from this standard visualization graphs VOSviewer software was used to identify more about

contributing authors, institutions, source titles and countries which are visualized in maps so as to highlight discrete developments in research collaborations.

5 Data analysis and interpretations

5.1 Forms of publications

Table 1 Forms of publications

S. No.	Forms of publications	No. of publications	Percentage
1	Journal Articles	22518	40.90
2	Editorial Material	8806	16.00
3	Letter	8774	15.94
4	Early Access	6906	12.54
5	Review	4831	8.78
6	News Item	1904	3.46
7	Meeting Abstract	896	1.63
8	Correction	355	0.64
9	Book Review	24	0.04
10	Proceeding Paper	16	0.03
11	Data Paper	12	0.02
12	Retraction	7	0.01
Total		**55049**	**99.99**

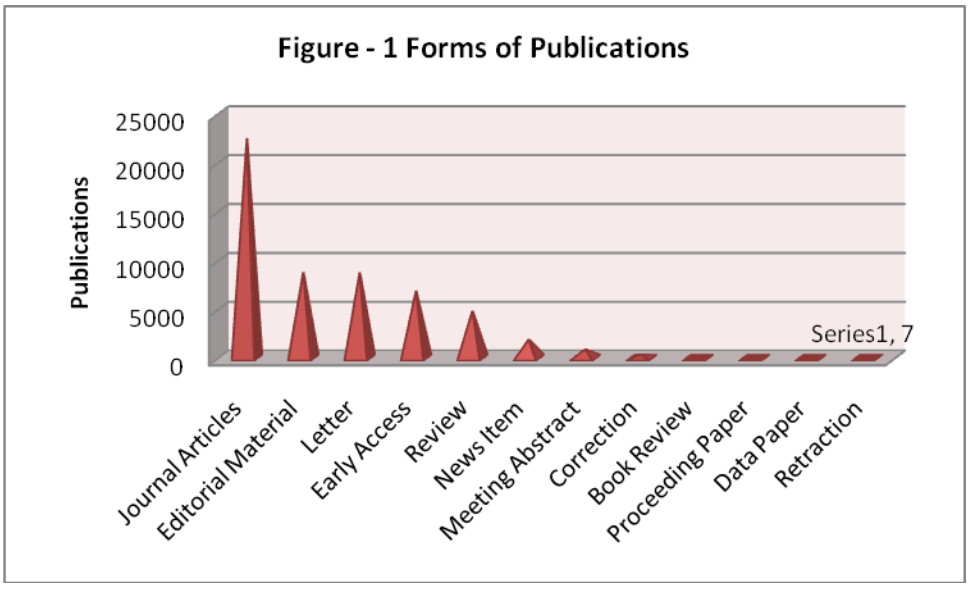

Figure 1 Forms of publications

Table 1 and Figure 1 reveals that the major source of publications covered by Web of Science database on COVID-19 research are Journal articles of 22518 (40.90%) followed by Editorial Material with 8806 publications (16%). Letter ranks the third position with 8774 publications (15.94%) followed by early access with 6906 publications (12.54%) and remaining forms of publications are less than ten percentage as seen in Table 1. The results indicate that the research outputs on the subject of the period covered by the study are mostly published in the form of journal articles.

5.2 Most Prolific Authors - Contributions and their H-Index

Table 2 Most Prolific Authors

S. No.	Author	Affiliations	TP	TC	ACPP	H-Index
1	Wang Y	Guangzhou University of Chinese Medicine, China	220	6862	31.19	33
2	Wang J	Nanjing University, China	196	6374	32.52	31
3	Zhang Y	Chinese Academy of Medical Sciences Peking Union Medical College, China	194	10487	54.06	28
4	Liu Y	Tulane University, USA	185	17939	96.97	33
5	Li Y	Shandong University of Traditional Chinese Medicine, China	179	2908	16.25	20
6	Liu J	Peking University School of Public Health, China	162	6221	38.40	27
7	Zhang L	Peking University, China	162	9214	56.88	28
8	Wang L	Huazhong University of Science and Technology, China	153	3819	24.96	26
9	Li J	Huazhong University of Science and Technology, China	151	2288	15.15	23
10	Chen Y	Chinese Academy of Science, China	137	3699	27	25

TP-Total Publications, TC - Total Citations, CPP- Citation per Publications

The authors having 130 or more publications during 2020 are shown in Table 5 along with their number of publications, citations, CPP and h-index. Wang, Y is the most productive author with 220 (0.40%) publications, 6862 citations, and 31.19 citations per publication followed by Wang, J with 196 (0.36%) publications, 6374 citations and 32.52 citations per

publication, Zhang, Y with 194 (0.35%) publications, 10487 citations, and 54.06 citations per publication, Liu, Y with 185 (0.34%) publications, 17939 citations, and 96.97 citations per publication, Li, Y with 179 (0.33%) publications, 2908 citations, and 16.25 citations per publication and Liu, J with 162 (0.29%) publications, 6221 citations, and 38.40 citations per publication and Zhang, L with 162 (0.29%) publications, 9214 citations, and 56.88 citations per publication respectively.

Authors from Liu Y, Tulane University, USA received the highest (96.97) citations per publication followed by Zhang L, Peking University, China with 56.88 citations per publication, Zhang Y, Chinese Academy of Medical Sciences Peking Union Medical College, China with 54.06 citations per publication and Liu J, Peking University School of Public Health, China with 38.40 citations per publication. During the period of the study, Liu Y, Tulane University, USA has received 17939 citations and his h-index is 33, which is a high h index among his peers.

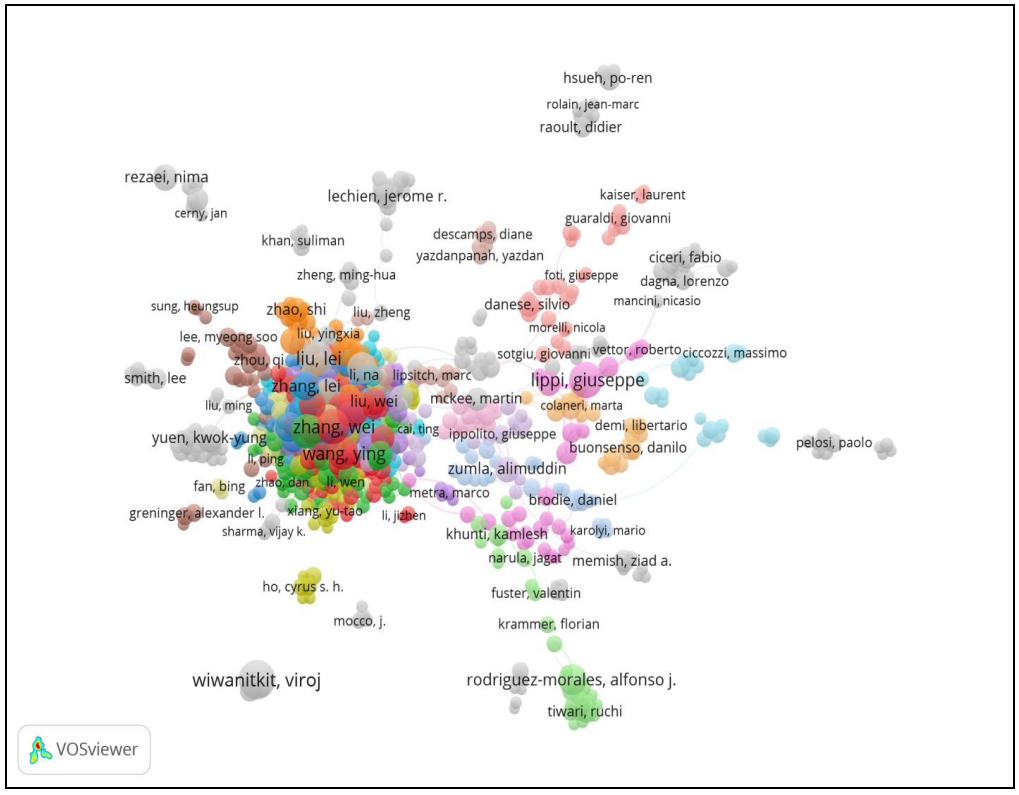

Figure 2 Most Prolific Authors

5.3 Most Productive Countries

Table 3 Most Productive Countries

Rank	Country	TP	TC	CPP	H-Index
1	USA	16470	171387	29.92	197

2	China	7367	143793	19.52	174
3	Italy	5942	49812	8.38	89
4	UK	5913	54644	9.24	99
5	Canada	2717	19948	7.34	63
6	India	2648	10557	3.98	41
7	Spain	2529	15915	6.29	53
8	Australia	2478	15790	6.37	55
9	Germany	2471	25067	10.14	71
10	France	2383	23301	9.78	69

Table 3 presents distribution of publications and citations of highly productive countries with more than 2300 publications. In all, there were 194 countries involved in COVID-19 literature, which published at least one publication. USA is the highly productive country with 16470 (29.92%) publications and 171387 citations followed by China with 7367 (44.73%) of publications and 143793 citations, Italy with 5942 (10.79%) of publications and 49812 citations, UK with 5913 (10.74%) publications and 54644 citations, Canada with 2717 (4.94%) publications and 19948 citations, India with 2648 (4.81%) of publications and 10557 citations and Spain with 2529 (4.59%) of publications and 15915 citations. Publications from USA received the highest citations per publication with 29.92 followed by China with 19.52 citations per publication, Germany with 10.14 citations per publication, France with 9.78 citations per publication and UK with 9.24 citations per publication.

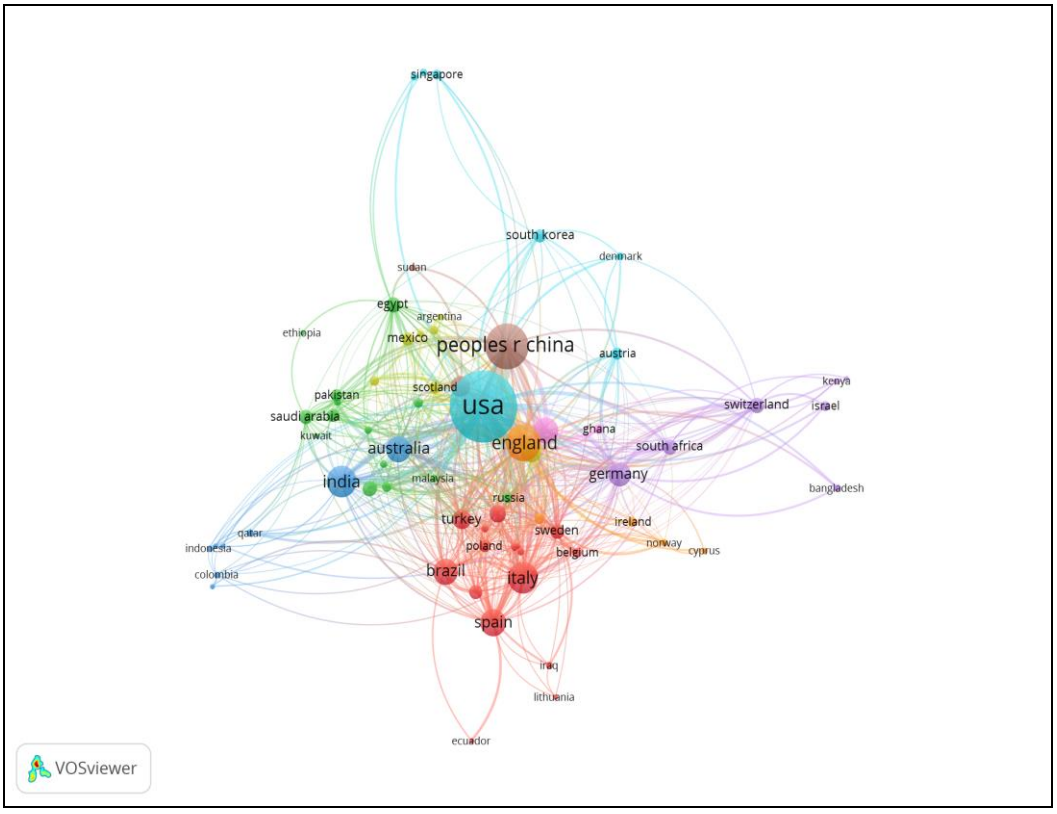

Figure 3 Most Productive Countries

5.4 Most Productive Global Organizations

Table 4 Most Productive Global Organizations

S. No.	Organizations	Country	TP	TC	ACPP	H Index
1	Harvard University	USA	1870	21540	11.52	68
2	University of London	UK	1796	21540	11.99	11.99
3	University of California System	USA	1393	14342	10.30	10.3
4	Harvard Medical School	USA	1147	15032	13.11	13.11
5	Huazhong University of Science and Technology	China	994	33487	33.69	33.69
6	Institut National de la Santé et de la Recherche Médicale (Inserm)	France	842	11466	13.62	13.62
7	University College London	UK	806	11272	13.99	13.99
8	University of Toronto	Canada	802	6721	8.38	8.38
9	Johns Hopkins University	USA	759	8147	10.73	10.73
10	Assistance Publique-Hopitaux de Paris	France	750	7990	10.65	10.65

TP-Total Publications, TC - Total Citations, ACPP- Average Citation per Publications

The top most productive institutions have published from 750 to 1870 publications and together contributed 20.27% (11159 publications) share in the cumulative world publications output. The scientometric profile of these top 10 institutions is presented in table 4. Among these top 10 institutions 4 are from USA, 2 from UK and France and one from China and Canada. Among institutions, the highly productive institutes were; Harvard University, USA with 1870 (3.39%) publications and 21540 citations with 11.52 citations per publication, University of London, UK with 1796 (3.26%) publications and 21540 citations with 11.99 citations per publication, University of California System, USA with 1393 (2.53%) publications and 14342 citations and 10.30 citations per publication, Harvard Medical School, USA with 1147 (2.08%) publications and 15032 citations with 13.11 citations per publication and Huazhong University of Science and Technology, China with 994 (1.81%) publications and 33487 citations with 33.69 citations per publication.

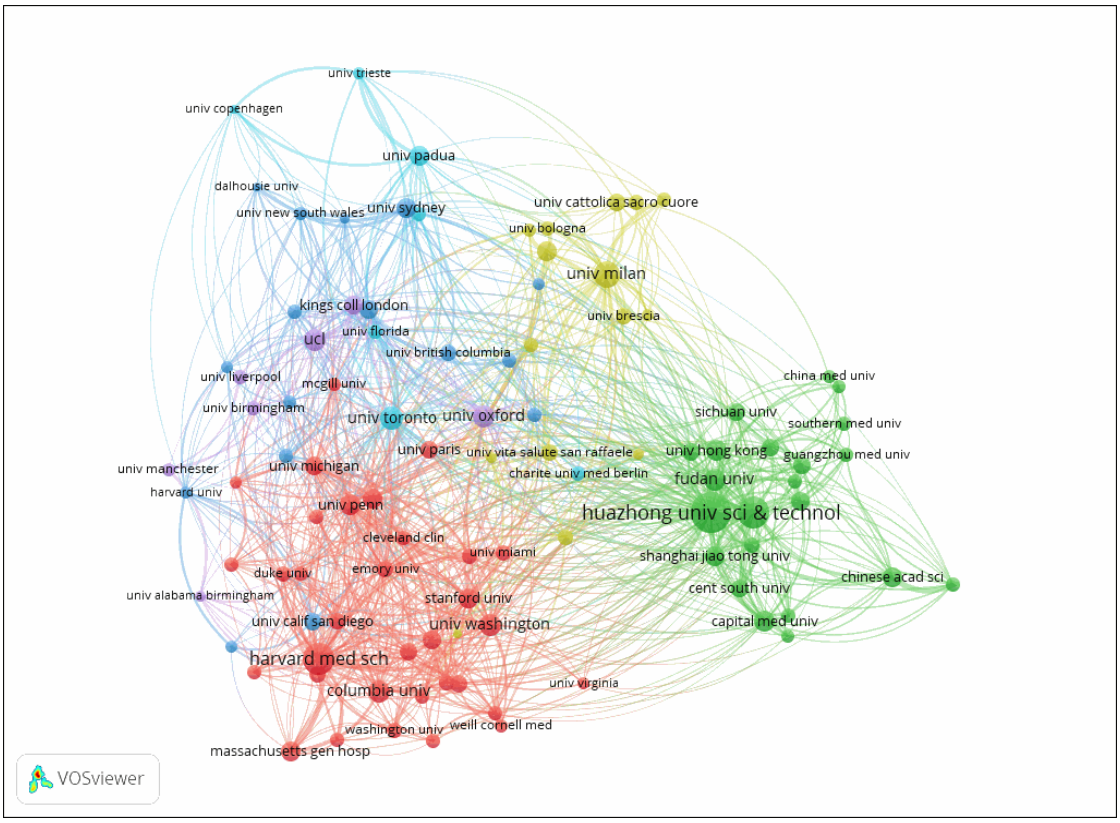

Figure 4 Most Productive Global Organizations

5.5 Medium of Research Communication

Table 5 High productive journals

Journal	TP	TC	CPP	H-Index
BMJ British Medical Journal	1158	6083	5.25	33
Journal of Medical Virology	636	8721	13.71	47
International Journal of Environmental Research and Public Health	631	3327	5.27	21
PLOS One	507	1072	2.11	14
LANCET	414	19843	47.93	58
Jama Journal of the American Medical Association	351	17946	51.13	50
International Journal of Infectious Diseases	300	4261	14.2	31
Sustainability	296	356	1.2	8
Frontiers in Public Health	270	582	2.16	9
Critical Care	267	1669	6.25	21

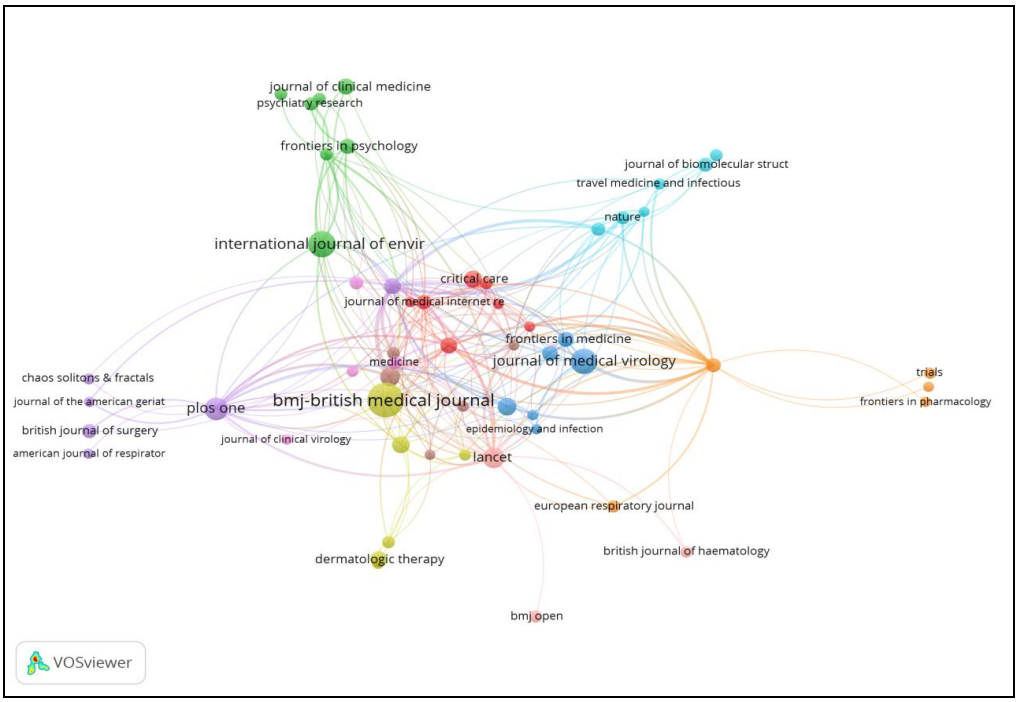

Figure 5 High productive journals

The scientific literature on COVID-19 literatures is spread over 4709 different journals which are indexed in Web of Science. Table 5 gives the leading journals with more than 250 publications each with number of publications, number of citations, citation per publications and h-index. BMJ British Medical Journal is the highly productivity journals with 1158 publications, 6083 citations, 5.25 citations per publications and h-index is 33 followed by Journal of Medical Virology with 636 publications, 8721 citations, 13.71 citations per publications and h-index is 47, International Journal of Environmental Research and Public Health with 631 publications, 3327 citations, 5.27 citations per publications and h-index is 21, PLOS One with 507 publications, 1072 citations, 2.11 citations per publications and h-index is 14, LANCET with 414 publications, 19843 citations, 47.93 citations per publications and h-index is 58 and Jama Journal of the American Medical Association with 351 publications, 17946 citations, 51.13 citations per publications and h-index is 50 respectively.

5.6 High Productivity Subject Areas

Table 6 High productivity subject areas

Subject	TP	TC	CPP	H-Index
General Internal Medicine	7800	103010	13.21	138
Public Environmental Occupational Health	4730	21233	4.49	58
Infectious Diseases	2971	40063	13.48	91

Cardiovascular System Cardiology	2575	23828	9.25	70
Neurosciences Neurology	2530	15259	6.03	51
Surgery	2525	11742	4.65	45
Immunology	2220	26795	12.07	86
Science and Technology	2207	22533	10.21	75
Psychiatry	2160	15682	7.26	54
Pharmacology Pharmacy	2085	15436	7.40	55

TP-Total Publications, TC - Total Citations, CPP- Citation per Publications

Table 6 shows high productivity subjects which are contributing more than 1600 articles. Among subjects, the highly productive subjects were: General Internal Medicine with 7800 publications and 103010 citations with 13.21 citations per publication, Public Environmental Occupational Health with 4730 publications and 21233 citations with 4.49 citations per publication, Infectious Diseases with 2971 publications and 40063 citations with 13.48 citations per publication, Cardiovascular System Cardiology with 2575 publications and 23828 citations with 9.25 citations per publication, Neurosciences Neurology with 2530 publications and 15259 citations with 6.03 citations per publication and Surgery with 2525 publications and 11742 citations with 4.65 citations per publication.

6 Summary and Conclusions

The COVID-19 pandemic is a very serious global public health problem. There have been rapid advances in what we know about the pathogen, how it infects cells and causes disease, and clinical characteristics of disease. The most affected country is USA which is also the top most productivity country and as India is being second but the literature productivity is less comparing with other countries. Further, due to rapid transmission, countries around the world should increase attention into disease surveillance systems, establishing rapid response teams and improving the capacity of the national laboratory system. There is a rapidly growing body of literature on this topic and hopefully it will help in finding an effective vaccine and the best practice for the management and treatment of symptomatic COVID cases. We hope that more global research collaboration should be encouraged for strengthening evidence based decision making preventing and addressing the COVID-19 pandemic and aftermath.

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