

Bibliometric Study of World COVID-19 Publication Output

OPEN ACCESS

Manuscript ID:
ASH-2021-08033489

Volume: 8

Issue: 3

Month: January

Year: 2021

P-ISSN: 2321-788X

E-ISSN: 2582-0397

Received: 07.10.2020

Accepted: 14.11.2020

Published: 01.01.2021

Citation:

Kappi, Mallikarjun, et al. "Bibliometric Study of World COVID-19 Publication Output." *Shanlax International Journal of Arts, Science and Humanities*, vol. 8, no. 3, 2021, pp. 86-95.

DOI:


<https://doi.org/10.34293/sijash.v8i3.3489>



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Abstract

The COVID-19 outbreak originating in Wuhan, Hubei province, China, coincided with chunky, the period of mass migration for the annual Spring Festival. To contain its spread, China adopted unprecedented nationwide interventions on January 23, 2020. These policies included large-scale quarantine, strict controls on travel, and extensive monitoring of suspected cases. However, it is unknown whether these policies have had an impact on the epidemic. We sought to show how these control measures impacted the containment of the epidemic. Web of Science database was searched on September 10, 2020, for COVID-19 publications published between 2019 to 2020. It was performed on the same day to avoid the possible bias from an update on the database because the metrics are changing over time. All publication types were considered; however, publications as errata were excluded. Analysis parameters include a year of publication, publication type, patterns of international collaboration, research institutions, journals, impact factor, h-index, language, and times cited. A total of 17,133 COVID-19 research publications were published across the world. The (COVID-19) associated publications were originated from 25 countries/territories, indicating the international spread of Corona virus COVID-19 research. The USA was the largest contributor, with 4767 (27.823%) articles published, followed by Peoples R China (2747 (16.033%)) articles.

Keywords: COVID-19, COVID 19, Bibliometric study, Web of science, World publications

Introduction

A cluster of viral pneumonia cases of unknown cause, subsequently identified as a novel coronavirus, named as 2019-nCov or COVID-19, was detected on December 31, 2019, in Wuhan, China. The disease has spread rapidly from Wuhan to other regions in China. Further, the dissemination of this virus has been observed in 216 countries and over 680354 deaths as of 2 August 2020 (Aristovnik et al., 2020). Bibliometric evaluation, a commonly accepted statistical tool, helps to present the knowledge structure of a particular research field. Throughout recent years, bibliometrics has been used to provide strong insights into several biomedical fields linked to many virus outbreaks

(Al-Jabi, 2017; Hagel et al., 2017; Wu et al., 2020; Zyou, 2016). There have been a few recent reviews of COVID-19 or Coronavirus (Zhou et al., 2020). The previously published bibliometric studies on COVID-19 have been published by using the Web of Science (WoS) database for data collection and were limited to biomedical research areas (Wu et al., 2020). Therefore, the purpose of the current COVID-19 research during the early stage of the outbreak through bibliometric analysis (Aristovnik et al., 2020b) determine the top-cited publications, and explore the current topics to provide the scientists and researchers hot topics to provide the scientists and researchers with a resource that can help them by identifying the current research priorities. (Joshua & Sivaprakasam, 2020).

Data Source & Methods

For this study, bibliometric data were collected from the Science Citation Index Expanded, Social Sciences Citation Index, and Emerging Sources Citation Index databases within the Web of Science (WoS) core collection. These databases within WoS are maintained by Clarivate Analytics, which offers the world's leading scientific citation search and analytical information platform¹⁸. Collectively WoS collection provides enriched bibliometric data useful for citation analytics and mapping the knowledge in a given domain by examining leading authors, institutions, and collaborating nations working in a given domain of scientific research. The following query was administered to retrieve COVID-19 related bibliometric data: “Novel coronavirus” OR “Novel coronavirus 2019” OR “2019 Novel coronavirus” OR “2019 nCoV” OR “COVID-19” OR “Wuhan coronavirus” OR “Wuhan pneumonia” OR “SARS nCoV” OR “SARS-CoV-2”. Considering the timing of the outbreak in late 2019, the search strategy was limited to 2019–2020 to retrieve data that may contain publications on COVID-19 rather than earlier coronaviruses. All search fields were selected, including topics, titles, and abstracts, to retrieve the bibliometric data ensuring the sensitivity of the search strategy. This search was conducted on September 10, 2019; no restrictions on languages or publication types were applied due to the low number of publications on this recent topic. The

inclusion criteria for this bibliometric study was as follows: a) journal articles published on COVID-19 topic, b) language of the publication was English, c) articles irrespective of their methodology were included, d) studies published between January 1, 2019, to September 2020, were included.

Furthermore, articles were excluded if they had conflicts with any of the above-mentioned inclusion criteria. The references of the retrieved articles were not evaluated. Therefore, articles retrieved through citation search are the only source of data in this bibliometric study. VOSviewer (van Eck & Waltman, 2010) (version 1.6.10) was used to analyze the Co-authorship, Co-occurrence, Citation, Bibliographic coupling, Co-citation, and themes.

Data Analysis and Results

On the topic of COVID-19, 17,133 publications were identified in the WOS database, which included 6882 (40.168%) original research articles, 4,378 (25.553%) early access, 4,179 (24.392%) editorials, and 1,694 other forms of publications containing letters, case reports, etc. majority of the publications (16,673, 97.315%) were written in English, followed by 188 German publications and 15,375 (89.73%) papers were open access. USA contributed 4767 (27.82%) followed by 2747 (16.03%) China contributed & India contributed 751 (4.38%) papers. Among 17,133 publications, 6787 papers got 69836 citations and 10346 publications uncited.

Forms used for Communicating COVID-19

Table 1 and Figure 1 illustrate the forms used for communicating COVID-19 research; these include articles published in scholarly journals, conferences and seminar proceedings, reviews, editorial materials, book chapters, meeting abstracts, etc. The study observed that a total of 17133 research publications in COVID-19. The majority of publications are published in Journal Articles, i.e., 6882 (40.168%) followed by Early Access 4378 (25.553%) publications, Editorial Material 4179 (24.392%) publications, 3825 (22.325%) published as Letters, 1546 (9.024%) publications are published as Review and also observed from the data that more than 99% of articles published in the English language.

Table 1: Covid-19 Forms of Communication

Document types	Records	% of 17133
Article	6882	40.168
Early Access	4378	25.553
Editorial Material	4179	24.392
Letter	3825	22.325
Review	1546	9.024
News Item	579	3.379
Correction	113	0.66
Book Review	4	0.023
Biographical Item	3	0.018
Proceedings Paper	2	0.012
Dance Performance Review	1	0.006
Data Paper	1	0.006
Meeting Abstract	1	0.006

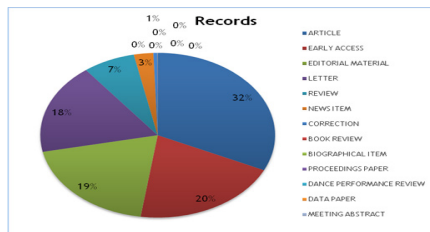


Figure 1: Covid-19 Forms of Communication

Language-Wise Distribution of World COVID-19 Research Publications

Table 2 and figure 2 indicates that Language-Wise Distribution of World COVID-19 Research Publications. Among 17133 publications, 97.315% (16673) published in English language, followed by German 188 (1.097%) papers, 99 (0.578%) papers in Spanish, French 98 (0.572%) publications, Portuguese 32 (0.187%) papers, Hungarian 25 (0.146%) papers, Italian 5 (0.029%) papers, and Chinese 13 (0.103%) papers were published.

Table 2: Language-Wise Distribution of World COVID-19

Languages	Records	% of 17133
English	16673	97.315
German	188	1.097
Spanish	99	0.578
French	98	0.572
Portuguese	32	0.187
Hungarian	25	0.146

Italian	5	0.029
Chinese	4	0.023
Czech	2	0.012
Polish	2	0.012
Slovak	2	0.012
Icelandic	1	0.006
Russian	1	0.006
Unspecified	1	0.006

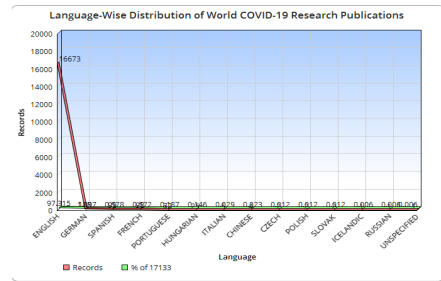


Figure 2: Language-Wise Distribution of World COVID-19

Distribution of Articles among Sub-Disciplines

The World literature about COVID-19 published during 2020 were extracted from the Web of Science citation database and classified under 20 major sub-disciplines. Table 3 and figure 3 Reveals that the top 20 major sub-disciplines of COVID-19. Medicine General Internal accounted for the largest publications i.e.2367 (13.815%) with 20507 Total Citations & 8.66 Average Citation followed by Public Environmental Occupational Health produced 1412 (8.241%) publications with 3182 Total Citations & 2.25 Average Citation, Surgery produced 984 (5.743%) publications with 2510 Total Citations & 2.25 Average Citation, Infectious Diseases produced 951 (5.551%) publications with 6864 Total Citations & 7.22 Average Citation and the top 3 h-index major sub-disciplines are Medicine General Internal with h-index 63, Infectious Diseases h-index of 41 and Immunology h-index of 3.

Table 3: Web of Science Categories

Web of Science Categories	Records	% of 17133	TC	ACPP	h-index
Medicine General Internal	2367	13.815	20507	8.66	63
Public Environmental Occupational Health	1412	8.241	3182	2.25	24
Surgery	984	5.743	2510	2.55	20
Infectious Diseases	951	5.551	6864	7.22	41
Psychiatry	666	3.887	1645	2.47	19
Cardiac Cardiovascular Systems	626	3.654	2324	3.72	23
Immunology	574	3.35	3168	5.52	31
Medicine Research Experimental	568	3.315	1875	3.30	22
Oncology	564	3.292	1392	2.47	17
Clinical Neurology	561	3.274	1256	2.24	15
Pharmacology Pharmacy	520	3.035	2034	3.91	21
Radiology Nuclear Medicine Medical Imaging	519	3.029	2298	4.43	24
Dermatology	472	2.755	1379	2.92	17
Pediatrics	465	2.714	1171	2.52	15
Virology	464	2.708	2803	6.04	28
Environmental Sciences	439	2.562	1021	2.33	14
Health Care Sciences Services	425	2.481	506	1.19	10
Hematology	424	2.475	1748	4.12	22
Biochemistry Molecular Biology	395	2.305	2260	5.72	27
Neurosciences	381	2.224	977	2.56	15

TC = Total Citation, ACPP = Average Citation per Paper

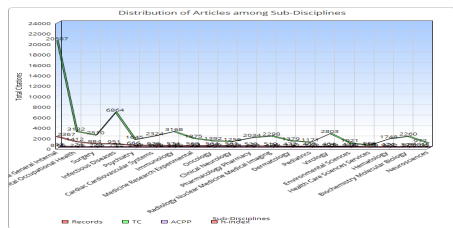


Figure 3: Distribution of Articles among Sub-Disciplines

Top 25 Productive Journals of COVID-19

Table 4 and figure 4 reveals the top productive sources preferred by the authors in COVID-19 research publications. They cover around one-fifth (19%) of total documents and cover more than 50% of total citations. The majority of these journals are subject to health sciences, and they are classified

mainly in the following sub-disciplines: infectious diseases, general medicine, and medical sciences. British Medical Journal first with 663 papers 3.87% of total publications and followed by Journal of Medical Virology contributed 325 (1.900%) publications, International Journal of Environmental Research and Public Health and Lancet were contributed 166 (0.970%) publications each and Psychological Trauma Theory Research Practice and Policy produced 145 (0.850%). New England Journal of Medicine got the highest total citations with an h-index of 32, followed by the Journal of the American Medical Association with 4634 total citations with an h-index of 29 and Lancet 4780 total citations with an h-index of 26 respectively. Figure 5 shows the VOS viewer Citation network of most productive journals.

Table 4: Top 25 Productive Journals

Source Titles	Records	TC	ACPP	h-index	% of 17133
BMJ British Medical Journal	663	1360	2.05	17	3.87
Journal of Medical Virology	325	1987	6.11	24	1.90
International Journal of Environmental Research and Public Health	166	430	2.59	9	0.97
Lancet	166	4780	28.8	26	0.97
Psychological Trauma Theory Research Practice and Policy	145	40	0.28	2	0.85
Critical Care	144	265	1.84	9	0.84
Dermatologic Therapy	142	276	1.94	8	0.83
Journal of Infection	138	727	5.27	14	0.81
New England Journal of Medicine	114	5881	51.59	32	0.67
Otolaryngology Head and Neck Surgery	110	162	1.47	7	0.64
International Journal of Infectious Diseases	107	883	8.25	15	0.63
British Journal of Surgery	103	441	4.28	9	0.60
JAMA Journal of The American Medical Association	102	4634	45.43	29	0.60
Head and Neck Journal for The Sciences and Specialties of The Head and Neck	94	219	2.33	6	0.55
Journal of The European Academy of Dermatology and Venereology	90	476	5.29	11	0.53
Science of The Total Environment	84	353	4.2	10	0.49
British Journal of Haematology	79	173	2.19	7	0.46
Journal of Biomolecular Structure Dynamics	79	417	5.28	10	0.46
Science	75	949	12.65	16	0.44
Nature	71	608	8.56	11	0.41
Nature Medicine	70	639	9.13	13	0.41
American Journal of Transplantation	69	437	6.33	13	0.40
Lancet Infectious Diseases	69	1778	25.77	17	0.40
Journal of Clinical Medicine	68	412	6.06	12	0.40
Lancet Respiratory Medicine	66	1428	21.64	13	0.39

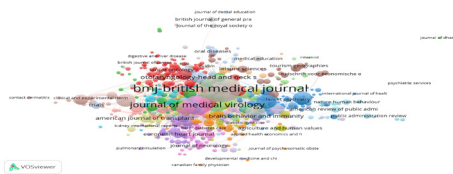


Figure 4: Citation Network of Most Productive Journals

Organisational-Wise Collaboration

Table 5 reveals 20 top research organizations in the world based on their highest research articles. According to the Web of Science database, the University of London contributed the highest publications to the field, i.e., 599(3.496%)

publications with 3949 citations, followed by Harvard University 547 (3.193%) publications with 3096 citations, University of California System 420 (2.451%) publications with 2248 citations, Huazhong University of Science Technology 375 publications with 7226 citations and King S College London places 20th with 166 (0.969%) publications. Among, the Huazhong University of Science Technology were placed top with 38 h-index followed by Harvard University, University of London, Wuhan University with 30, 28 & 27 h-index respectively. Figures 5 & 6 show the Co-authorship network of most productive organizations and the Citation network of most productive organizations.

Table 5: Organisational Collaboration

Organizations-Enhanced	Records	TC	ACP	h-index	% of 17133
University of London	599	3949	6.59	28	3.496
Harvard University	547	3096	5.66	30	3.193
University of California System	420	2248	5.35	26	2.451
Huazhong University of Science Technology	375	7226	19.27	38	2.189
Harvard Medical School	336	2076	6.18	23	1.961
University College London	274	2068	7.55	17	1.599
Assistance Publique Hopitaux Paris APHP	257	1118	4.35	14	1.500
Institut National De La Sante Et De La Recherche Medicale Inserm	255	1244	4.88	19	1.488
University of Toronto	236	1343	5.69	17	1.377
University of Milan	230	1589	6.91	17	1.342
University of Texas System	218	834	3.83	14	1.272
Johns Hopkins University	211	1285	6.09	15	1.232
Wuhan University	209	2817	13.48	27	1.220
University of Oxford	194	1892	9.75	18	1.132
National University of Singapore	173	1759	10.17	22	1.010
Sapienza University Rome	170	539	3.17	12	0.992
University of Pennsylvania	169	986	5.83	15	0.986
University of Washington	169	1418	8.29	15	0.986
Imperial College London	168	1193	7.1	17	0.981
King S College London	166	804	4.84	13	0.969



Figure 5: Co-authorship Network of Most Productive Authors

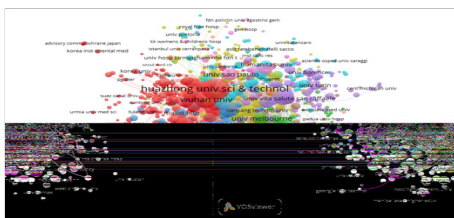


Figure 6: Citation Network of Most Productive Organizations

Most Productive Authors in COVID-19

Table 6 Shows the highly productive authors of COVID-19 related articles, total citations, and h-index during the study period. The first one is, Wang Y contributed 92 (0.537%) publications followed by Li Y 76 (0.444%), Wang J 75 (0.438%), and Li W placed last in the table with 41 (0.239%) publications. Liu Y was got 4831 total citations with 18 h-index, followed by Wang Y 1471 with 17 h-index. Liu L, Wang J, Zhang Y, Wang L were having 16, 15, 15, 14 h-index, respectively. Figure 7 & 8 show the Co-authorship network of authors & Citation network of authors.

Table 6: Most Productive Authors

Authors	Records	TC	ACPP	h-index	% of 17133
Anonymous	216	205	0.95	7	1.261
Wang Y	92	1471	15.99	17	0.537
Li Y	76	567	7.46	10	0.444

Wang J	75	1293	17.24	15	0.438
Li L	74	2467	33.26	11	0.432
Mahase E	72	88	1.22	4	0.420
Liu J	61	2532	41.51	13	0.356
Wang L	61	621	10.18	14	0.356
Zhang Y	60	2419	40.32	15	0.350
Liu Y	59	4831	81.88	18	0.344
Zhang L	58	860	14.83	10	0.339
Iacobucci G	56	32	0.57	3	0.327
Chen Y	50	761	15.22	12	0.292
Li J	48	341	7.1	8	0.280
Liu L	46	2741	59.59	16	0.268
Wiwanitkit V	46	103	2.24	4	0.268
Yang L	43	444	10.33	6	0.251
Zhang J	43	172	4	6	0.251
Chen J	42	534	12.71	10	0.245
Li W	41	378	9.22	9	0.239

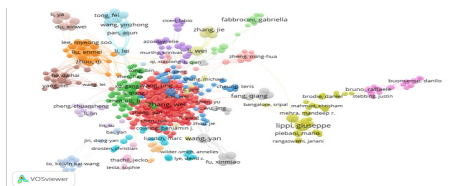


Figure 7: Co-authorship Network of Authors

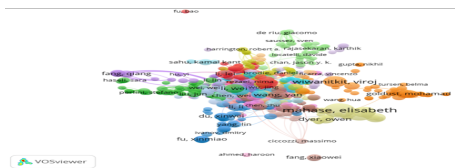


Figure 8: Citation Network of Authors

International Linkages of COVID-19

The geographical distribution of articles presented in Table 7, which gives the country wise-distribution of research publications contribution. Out of 17133 research articles, the USA contributed the highest number of research articles, 4767 (27.823%), followed by China with 2747 (16.033%), Italy with 2136 (12.467%), England with 1913(11.166%), Canada with 861 (5.025%), Germany with 801 (4.675%) and India with 751 (4.383%) publications. Figures 9 & 10 show the Co-authorship Countries network and the Citation network of countries.

Table 7: Country Wise-Distribution

Countries / Regions	Records	% of 17133
USA	4767	27.823
Peoples R China	2747	16.033
Italy	2136	12.467
England	1913	11.166
Canada	861	5.025
Germany	801	4.675
India	751	4.383
France	749	4.372
Australia	729	4.255
Spain	610	3.56
Brazil	501	2.924
Switzerland	442	2.58
Iran	395	2.305
Netherlands	360	2.101
Singapore	338	1.973
Turkey	335	1.955
Belgium	281	1.64
Japan	266	1.553
South Korea	254	1.483
Sweden	200	1.167
South Africa	197	1.15
Scotland	196	1.144
Taiwan	187	1.091

Austria	176	1.027
Greece	174	1.016

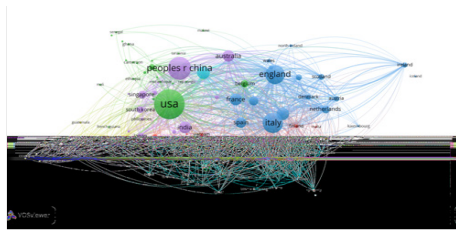


Figure 9: Co-authorship Countries Network

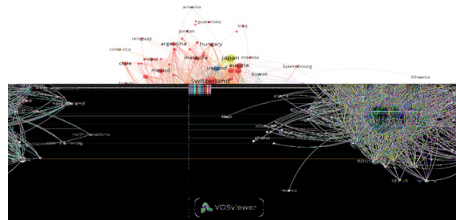


Figure 10 Citation Network of Countries

Top 25 Funding Agencies in the field of COVID-19

Table 8 reveals the top 25 funding Institutions for COVID – 19 research in the world based on their highest publications. The top funding agency was the National Natural Science Foundation Of China, which funded 622 publications, followed by the United States Department Of Health Human Services (563 publication), National Institute Of Health NIH USA (545 publications), National Key Research And Development Program Of (82 publications). Top 25 funding Instituitues funded 17 % of publications.

Table 8: Top 25 Funding Agencies

Funding Agencies	Records	% of 17133
National Natural Science Foundation of China	622	3.630
United States Department of Health Human Services	563	3.286
National Institutes of Health NIH USA	545	3.181
National Key Research and Development Program of China	82	0.479
Wellcome Trust	81	0.473
National Institute for Health Research NIHR	78	0.455

NIH National Heart Lung Blood Institute NHLBI	73	0.426
Fundamental Research Funds for The Central Universities	72	0.420
NIH National Institute of Allergy Infectious Diseases NIAID	66	0.385
National Council for Scientific and Technological Development CNPQ	62	0.362
European Union Eu	57	0.333
National Science Foundation NSF	57	0.333
Canadian Institutes of Health Research CIHR	56	0.327
Projekt Deal	54	0.315
National Key R D Program of China	52	0.304
Gates Foundation	47	0.274
NIH National Cancer Institute NCI	43	0.251
NIH National Institute of General Medical Sciences NIGMS	42	0.245
Medical Research Council UK MRC	40	0.233
Capes	36	0.210
German Research Foundation DFG	36	0.210
China Postdoctoral Science Foundation	34	0.198
European Research Council ERC	34	0.198
National Health and Medical Research Council of Australia	34	0.198
NIH National Institute on Aging Nia	34	0.198

Highly Prolific Keywords Network

The keywords in the 17133 publications measured in the present study were analyzed using VOSviewer (Figure 11). A total of 25 keywords identified as having occurred more than 90 times in the title and abstract fields across all articles. These keywords appeared in all publications; the study was classified as clusters. Covid-19 (6180 times) was used, followed by sars-Nov-2 (1926 times) and coronavirus (1570 times). Seventeen keywords were used 100 to 1000 times, and five keywords were used 90-100 times, respectively (Table 9).

Table 9

Keyword	Occurrences
covid-19	6180
sars-cov-2	1926
Coronavirus	1570
Pandemic	785
Pneumonia	238
coronavirus disease 2019	188
Public health	183
Epidemiology	173
Mental health	170
Pandemics	153
Telemedicine	150
2019-ncov	138
ace2	120
Infection	118
Sars	108
Infectious disease	105
Anxiety	104
Children	103
Severe acute respiratory syndrome coronavirus 2	103
covid-19 pandemic	102
Hydroxychloroquine	97
Novel coronavirus	97
Outbreak	97
Treatment	94
Pregnancy	93



Figure 11: Analyses of Keywords Network

Discussion and Conclusion

Results of the study reflect the current world scholarly publications on COVID-19 found 17,133 publications in the WOS database, which included 6882 (40.168%) original research articles, 4,378 (25.553%) early access, 4,179 (24.392%) editorials, and 1,694 other forms of publications containing

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