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Abstract

The novel coronavirus disease 2019 (COVID-19) has affected almost all the countries globally, and it is considered a global pandemic. Hence, this study conducted a bibliometric analysis of scientific output on the COVID-19 pandemic outbreak using the Web of Science (WoS) database. A specific search technique was developed based on Corona virus-related keywords from January 1, 2019, until June 24, 2020. A total of 10850 documents related to COVID-19 published from January 1, 2019, to June 24, 2020, were retrieved from the WoS database. The researchers downloaded the data from WoS as a WoS plain text file, and the data were analyzed using R studio (biblioshiny) software. Out of the total of 10850 documents published in 1736 scientific journals, 10845 papers belonging to the year 2020, which constituents 99.954% of the total documents (N=10850). Wang Y is the most productive author who contributed 0.60% (n=65) of the total documents published. USA is the predominant country that produced 2701 documents related to COVID-19, and China follows it with 1937 documents. The most active collaboration held between the USA and China, and it accounted for 2.75% (n=298) of the entire documents (N=10850).

Keywords: Bibliometric analysis, COVID-19, Novel coronavirus infection, Pandemic, SARS-CoV-2, Web of Science

Introduction

Corona Virus disease 2019 (COVID-19) is an infectious disease that occurs due to the novel coronavirus termed "severe acute respiratory coronavirus 2 (SARS-CoV-2)" (Li, Liu, Yu, Tang, & Tang, 2020). The coronavirus is an RNA virus having a crown-like appearance while viewing with an electron microscope. Such appearance arises due to the glycoprotein spikes on its envelope (Richman, Whitley, & Hayden, 2016). The spread of this virus occurs rapidly from one to another through respiratory droplets that produced coughing and sneezing. The duration from exposure and symptom onset is usually between 2 and 14 days, with an average of five days. The common symptoms are fever, cough, sneezing, and shortness of breath (Hafeez, Ahmad, Siddqui, Ahmad, & Mishra, 2020). Due to coronavirus, the COVID-19 outbreak was observed in December 2019 at Wuhan, Hubei, China (Chahrour et al., 2020). On March 11, 2020, the World Health Organization (WHO) declared this disease as a pandemic as the virus infecting 118,000 persons and causing over 4000 deaths in 114 countries (World Health Organization, 2020). The virus is having a high infectivity rate, which develops an issue in countries where healthcare services became saturated and unable to accommodate patients (Spina et al., 2020). Presently, no recognized vaccines or medications were found against SARS-CoV-2. Current medical treatment embraces preventive and infection control measures and supportive care (Wu et al., 2020). Nevertheless, to overcome COVID-19, the clinicians are using various antivirals, and anti-inflammatory drugs based on expert opinion, as well as randomized trials, prospective, and case series stated around the globe (Murthy, Gomersall, & Fowler, 2020).

Moreover, COVID-19 has turned into central attention among medical and scientific institutions worldwide for the past few months (Chahrour et al., 2020). Across the globe, the

researchers have recently analyzed the COVID-19 research using various databases, especially in the Web of Science (WoS) (Hossain, 2020; Mao, Guo, Fu, & Xiang, 2020; Nasab & Rahim, 2020; Neto et al., 2020; Zhou & Chen, 2020). Notably, the WoS database gained its importance as the Clarivate analytics WoS is recognized as the world's leading scientific citation search and analytical platform utilized as a research dataset and instrument (Li, Rollins, & Yan, 2018; Sun & Yuan, 2020). It is a commonly used one to conduct bibliometric studies covering the most impressive and evident research papers (Sun & Yuan, 2020). On reviewing the literature, Mao et al. (2020) assessed the global status and trends of coronavirus research using the WoS database from January 1, 2003, to February 6, 2020. Nasab and Rahim (2020) studied the research publications concerning COVID-19 using WoS, Scopus, and PubMed databases on March 02, 2020 and updated on March 10, 2020. Zhou and Chen (2020) studied the global coronavirus research trends over the past two decades (i.e., from January 1, 2020, to March 17, 2020) using the WoS database. Neto et al. (2020) also conducted bibliometric research to map the global scientific output on COVID-19 as of March 20, 2020, using the WoS database. Specifically, Hossain (2020) conducted a bibliometric analysis and knowledge mapping of global research on COVID-19 using the WoS database from January 1, 2019, to April 1, 2020. While analyzing these studies, the recent bibliometric analysis on COVID-19 was conducted on April 1, 2020, using the WoS database. On the other hand, several researchers are continually engaged in the research on the COVID-19 outbreak as its spread is showing an increasing trend.

In line with earlier studies, the present one attempted to address how the COVID-19 pandemic outbreak influences the publication count and the authors' affinity towards publishing COVID related research, especially from the year 2019 to June 24, 2020. Further, it attempted to

find the top ten most productive journals and most active researchers who have published COVID-19 related documents. This study also tried to add to the existing literature about the most productive country concerning the number of publications and citations and the top ten collaborating countries involved in COVID 19 research. As a measure to fulfill all the above objectives, this study aimed to conduct a bibliometric analysis of scientific output on COVID-19 Pandemic Outbreak using the WoS database.

Methods

Descriptive study design was adopted to reveal the scientific output on COVID-19 using an electronic literature search in the WoS database from January 1, 2019, to June 24, 2020. As the COVID-19 outbreak was initially observed in December 2019, the search was restricted to 2019-2020 to assess the scientific output on COVID-19 instead of other coronavirus variants. The findings of this study are based on the search conducted on June 24, 2020. The search terms used for literature search in the WoS database include TS= ("COVID-19" OR "2019 novel coronavirus infection" OR " COVID19" OR "coronavirus disease 2019" OR "coronavirus disease-19" OR "2019-nCoV disease" OR "2019 novel coronavirus disease" OR "2019-nCoV infection" OR "COVID19 virus" OR "COVID-19 virus" OR "coronavirus disease 2019 virus" OR "SARS-CoV-2" OR "2019-nCoV" OR "2019 novel coronavirus"). As a result, a total of 10850 documents were retrieved and included in this study. No documents were excluded. The data was downloaded from the WoS database as a WoS plain text file and proceeded for further analysis. The information on the publication trend, authors, affiliations, journals, top-cited countries as well as documents, country-wise collaboration, and keywords were analyzed using the R studio (biblioshiny) software.

Results

Publication Trend

Using the WoS database, 10850 COVID-19 documents were retrieved and included in this study. While reviewing the results, it is observed that 99.954% (n=10845) of them were published in the year 2020. However, a negligible percentage of documents were published in 2019, i.e., 0.046% (n=5). Table 1 summarizes the bibliometric documents published between January 1, 2019, and June 24, 2020, in the WoS database. A total of 37762 authors contributed to the total documents (N=10850) with 3.48 authors per document. From the results, single-authored documents were observed as 2451, and the average citation per document was found as 4.02 (Table 1). Concerning the document types, 25.57% (n=2774) were articles, and 21.26% were editorial material (Table 2).

Table 1

Summary of the Bibliometric Documents

Description	Results
Total Documents	10850
Sources (Journals, Books, etc.)	2236
Keywords Plus (ID)	4163
Author's Keywords (DE)	8978
Average Citations per Documents	4.02
Authors	37762
Author Appearances	53572
Authors of Single-Authored Documents	1799
Authors of Multi-Authored Documents	35963
Single-authored Documents	2451
Documents per Author	0.287
Authors per Document	3.48
Co-Authors per Documents	4.94
Collaboration Index	4.28

Table 2

Types of COVID-19 Documents retrieved from the WoS database between January 1, 2019, and June 24, 2020

Document Types	Frequency
Article	2774
Article; Data Paper	2
Article; Early Access	1245
Article; Proceedings Paper	2
Biographical-Item	1
Book Review	1
Correction	74
Correction; Early Access	19
Dance Performance Review	1
Editorial Material	2307
Editorial Material; Early Access	740
Letter	1311
Letter; Early Access	929
Meeting Abstract	2
News Item	455
News item; Early access	1
Reprint	1
Review	749
Review; Early Access	236
Total	10850

Top 10 Authors

From a total of 37082 authors, the top 10 authors were identified based on the number of publications related to COVID-19 and listed in Table 3. These authors contributed 4.32% (n=469) of total documents (N=10850). Among these authors, Wang Y, Mahase E, and Liu Y had collectively accounted for 1.55% (n=168) of the entire documents (N=10850). Wang Y had contributed to 0.60% (n=65) of the total documents (N=10850). Each of the top 10 authors had contributed a minimum of 40 documents to the total (N=10850).

Table 3

Top 10 Authors who published COVID-19 Documents

Author	Publications (n)	Percentage (%)
Wang Y	65	0.60
Mahase E	54	0.50
Liu Y	49	0.45
Wang L	47	0.43
Iacobucci G	43	0.40
Li J	43	0.40
Wang J	43	0.40
Zhang Y	43	0.40
Liu J	42	0.39
Li Y	40	0.37

Top 10 Institutions

The top 10 institutions observed in the retrieved COVID-19 documents are listed in Table 4. It is observed that an institution named "Huazhong University of Science and Technology" had published more number of COVID-19 documents (n=423) and accounted for 3.90% of the total documents (N=10850).

Table 4

Top 10 Institutions observed in COVID-19 Documents

Institutions	Publications (n)	Percentage (%)
Huazhong University of Science and Technology	423	3.90
Wuhan University	315	2.90
Fudan University	212	1.95
Harvard Medical School	201	1.85
University of Milan	188	1.73
University of Toronto	188	1.73
University of Hong Kong	161	1.48
Zhejiang University	154	1.42
Tehran University of Medical Sciences	152	1.40
University of Washington	147	1.35

Top 10 Journals

While reviewing the results, 1736 peer-reviewed journals had published 10850 COVID-19 documents. Table 5 depicts the top 10 journals that published scientific papers related to the COVID-19 outbreak. These journals published 13.24% (n=1437) of the total documents (N=10850) in the study period. Among these journals, the journal named "BMJ-British Medical Journal" was found to be the most productive journal that published 4.26% (n=462) of the total documents (N=10850).

Table 5

Top 10 Journals that published COVID-19 Documents

Journals	Publications (n)	Percentage (%)
British Medical Journal (BMJ)	462	4.26
Journal of Medical Virology	222	2.05
Lancet	151	1.39
Cureus	118	1.09
Head and Neck-Journal for the Sciences and Specialties of the Head and Neck	89	0.82
Otolaryngology-Head and Neck Surgery	86	0.79
New England Journal of Medicine	83	0.76
Journal of the American Medical Association (JAMA)	80	0.74
Nature	74	0.68
Critical care	72	0.66

Top 10 Countries that published COVID-19 Documents

Table 6 shows that the USA was the leading one among the top 10 countries that published 2701 COVID-19 documents in the study period. It contributed to 24.89% of the total documents (N=10850). Subsequently, the other top countries that published COVID-19 documents were observed as People R China (n=1937; 17.85%) and Italy (n=1327; 12.23%).

Table 6

Top 10 countries that published COVID-19 Documents

Country	Publications (n)	Percentage (%)
USA	2701	24.89
Peoples R China	1937	17.85
Italy	1327	12.23
England	1120	10.32
India	506	4.66
Canada	500	4.61
Germany	467	4.30
France	448	4.13
Australia	439	4.05
Spain	314	2.89

Top 10 Cited Countries

Among the top 10 cited countries, COVID-19 documents published by China received 24003 citations with the average citation of 14.25, followed by the USA received 6231 citations and an average citation of 3.12, and United Kingdom received 2355 citations and average citation of 3.05 (Table 7).

Table 7

Top 10 Cited Countries concerning COVID-19 Documents

Country	Total Citations	Average Citation (citations per document)
China	24003	14.25
USA	6231	3.12
United Kingdom	2355	3.05
Italy	1959	1.86
Germany	1343	4.83
Singapore	750	4.66
France	637	2.00
Canada	623	2.12
Switzerland	442	3.51
Korea	403	3.44

Top 10 Country-wise Collaboration

Table 8 described the top 10 country-wise collaboration that published the documents related to the COVID-19 outbreak. This study observed the strongest collaboration between the USA and China that had highly contributed about 2.75% (n=298) of the total documents (N=10850).

Table 8

Top 10 Countries collaborated concerning COVID-related publications

Collaboration between countries		Publications (n)	Percentage (%)
USA	China	298	2.75
USA	United Kingdom	237	2.18
Italy	USA	192	1.77
Italy	United Kingdom	174	1.60
USA	Canada	161	1.48
USA	Australia	144	1.33
China	United Kingdom	132	1.22
USA	Germany	117	1.08
United Kingdom	Australia	109	1.00
Germany	United Kingdom	104	0.96

Top 10 cited COVID-19 Documents

Table 9 described the top 10 cited COVID-19 documents. Among these documents, a document published by the author "Huang CL (2020)" in the journal "Lancet" received a high number of 1792 of citations. Half of the top 10 cited COVID-19 documents (n=5) were published in the journal named "Lancet" and received a minimum of 500 citations of each.

Table 9

Top 10 cited COVID-19 Documents

First Author and Source of Documents	Total Citations
Huang CL, 2020, Lancet	1792
Wang DW, 2020, Journal of the American Medical Association (JAMA)	1076
Chen NS, 2020, Lancet	991
Zhu N, 2020, New England Journal of Medicine	968
Guan W, 2020, New England Journal of Medicine	952
Li Q, 2020, New England Journal of Medicine	708
Zhou P, 2020, Nature	700
Zhou F, 2020, Lancet	631
Chan JFW, 2020, Lancet	589
Lu RJ, 2020, Lancet	519

Top 10 Keywords

The common keywords used by authors in their publications concerning the COVID-19 outbreak are depicted in Figure 1. A total of 8978 keywords was used in the COVID-19 documents published in the study period. Further, the top 10 keywords used by authors in their publications are also described in Table 10. Out of top 10 keywords, those with a frequent rate of occurrence were identified as "covid 19" (n=3391; 37.77%), "sars cov 2" (n=1181; 13.15%), and "coronavirus" (n=1103; 12.29%).
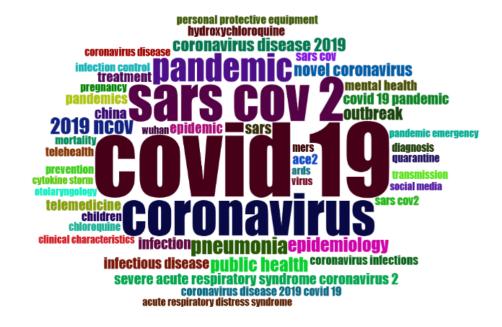
Figure 1. Keywords used in Publications on COVID-19 outbreak by Authors

Table 10

Top 10 Keywords used in COVID-19 Documents

Keywords	Publications (n)	Percentage (%)
covid 19	3391	37.77
sars cov 2	1181	13.15
coronavirus	1103	12.29
pandemic	490	5.46
pneumonia	183	2.04
2019 ncov	172	1.92
public health	137	1.53
epidemiology	134	1.49
coronavirus disease 2019	114	1.27
novel coronavirus	108	1.20

<center>**Discussion**</center>

Publication Trend

A recent study by Hossain (2020) revealed the publications concerning COVID-19 in the WoS database from January 1, 2019, to April 1, 2020. The search was conducted on April 1, 2020. In adherence to their inclusion criteria, 422 publications were included in which 141 were articles, and only 24 were reviews. Unlike the previous study, this study observed the publications on the COVID-19 outbreak in the WoS database from January 1, 2019, to June 24, 2020. A total of 10850 documents was retrieved as of June 24, 2020. The year-wise publication trend showed that 99.954% (n=10845) of documents were published in the year 2020, whereas only five documents were published in the years 2019. Among the retrieved documents, 2774 were articles, and 749 were reviews. The researchers' affinity towards the conduct of research on COVID might be due to the sudden outbreak of COVID-19 in December 2019 at Wuhan, China, and its rapid spread across the world (Hafeez et al., 2020). Later, it turned into a pandemic situation, which the WHO declared in March 2020 (World Health Organization, 2020). As of April 15, 2020, it spread in 210 countries and territories across the globe and exposed its presence in six continents (Hafeez et al., 2020). Such a global pandemic of COVID-19 makes the medical researchers conduct more research concerning the COVID-19 outbreak in 2020, thereby sharing their opinions and findings with others.

Productive Authors

An earlier study conducted by Hossain (2020) using the WoS database between January 01, 2019, and April 01, 2020, concluded that Mahase E was the leading author among the top authors and contributed 3.08% (n=13) of total publications (N=422) on COVID-19. In contrast, the present study observed that the top 10 authors contributed to 4.32% (n=469) of total

<center>15</center>

publications (N=10850). Among them, Wang Y was the leading one who contributed to 0.60% (n=65) of the total publications (N=10850).

Contributive Institutions

A study by Mao et al. (2020) revealed that the publications on coronavirus from January 1, 2003, to February 6, 2020, in the WoS database. The study results showed that "The University of Hong Kong" was the most productive institution with the publication count of 452 and contributed 4.87% of the total publications related to coronavirus research (N=9294). Likewise, Zhou and Chen (2020) analyzed the global trends of coronavirus research published between January 1, 2020, and March 17, 2020, using the WoS database. It is observed that "The University of Hong Kong" was the most contributive one among the top 15 institutions with 434 coronavirus publications. On the other hand, this study found that "Huazhong University of Science and Technology," an institution which accounted for 3.90% of the total COVID-19 related documents (N=10850) with its publication count (n=423).

Productive Journals

Nasab and Rahim (2020) conducted a bibliometric analysis of global scientific research on SARS-CoV-2 (COVID-19) using WoS, PubMed, and Scopus database from 2019 to 2020. The online search was conducted on March 02, 2020, and updated on March 10, 2020. In their study, the top 10 journals had published 47 articles about COVID-19, which accounted for 51.08% of total publications (N=92). Another study by Neto et al. (2020) observed 64 articles concerning COVID-19 in the WoS database as of March 20, 2020. It is found that the journals named "British Medical Journal (BMJ)" published ten articles with three citations and attained the leading position among the top 10 journals. Besides, Hossain (2020) revealed that the "British Medical Journal (BMJ)" was one among the top 10 journals that accounted for 11.61% (n=49) of

total publications COVID-19 (N=422) in the WoS database. The impact factor, as per the Journal citations report 2018 of this journal, is observed as 27.604. Similar to these studies, the current study also focused on the WoS database and concluded that the top 10 journals published 1437 documents concerning the COVID-19 outbreak, where it accounts for 13.24% of total publications (N=10850). Out of the top 10 journals, the "British Medical Journal (BMJ)" was found to be the most active journal that contributed to 4.26% (n=462) of the total publications (N=10850). In contrast, Zhou and Chen (2020) found that 9.764% (n=883) of total publications (N=9043) related to coronavirus were published by the most productive journal named "Journal of Virology," according to the data retrieved from the WoS database. Mao et al. (2020) also observed the journal titled "Journal of Virology" as one of the core journals of coronavirus research using the WoS database. This controversy about the most productive journal between these studies is due to the different periods set in the inclusive criteria to screen the coronavirus or COVID-19 articles published in the WoS database (Hossain, 2020; Mao et al., 2020; Neto et al., 2020; Zhou & Chen, 2020).

Productive Countries

Previous studies observed that the USA was the most productive country with the highest number of publications related to coronavirus research in the WoS database (Mao et al., 2020; Zhou & Chen, 2020). Following these studies, the current study also revealed that the USA was the leading one among the top 10 countries that published 2701 COVID-19 documents in the WoS database. It accounted for 24.89% of the total publications (N=10850). In contrast, Hossain (2020) revealed that China published the highest number of COVID-19 related documents (n=185) in the WoS database.

Most Cited Countries

Mao et al. (2020) revealed that the USA's publications related to coronavirus in the WoS database had a high number of citations (n=114273). However, this study observed that COVID-19 documents published by China had more citations (n=24003) among the top 10 cited countries.

Most Cited COVID-19 Documents

Hossain (2020) observed that a COVID-19 document by Huang C in the journal named "Lancet" scored more citations (n=124) as of the bibliometric analysis using the WoS database. In line with this finding, this study observed that Huang CL published a document on COVID-19 in the journal named "Lancet" had 1792 citations. However, Neto et al. (2020) found that Huang et al. published a coronavirus research document in the journal named "Lancet," which gained 21 citations. Further, Zhou and Chen (2020) reported the most cited documents on coronavirus research using the WoS database. It is observed that Ksiazek et al. published an article in the journal named "New England Journal of Medicine," which received 1839 citations.

Country-wise collaboration

Dehghanbanadaki et al. (2020) revealed the international collaboration network between 32 countries with at least five COVID-19 publications in the Scopus database. By network mapping, 241 international collaborations were witnessed. The strongest collaboration was observed between China and the United States. Whereas, this study revealed that the United States published a high number of COVID-19 documents (n=298) in collaboration with China, i.e., 2.75% of total publications (N=10850) in the WoS database.

Keywords

While reviewing the previous studies, Nasab and Rahim (2020) reported that the "Coronavirus" was the more frequently used keywords (i.e., 224 times) in COVID-19 related articles published in WoS, PubMed, and Scopus database. Likewise, Hossain (2020) observed the most frequent keyword as "Coronavirus" (n=69) in articles using the WoS database. In this study, the top 10 keywords used by the authors in their publications were revealed using the WoS database. Among those keywords, "covid 19" was observed with the high frequency of occurrence (n=3391).

Conclusion

This study observed that the scientific output on the COVID-19 pandemic outbreak had an abrupt rise in number, especially in 2020. The top 10 authors and journals publishing COVID-19 related documents were discussed. A strong collaboration was found between the United States and China in publishing COVID-19 related documents. Though there are more publications on COVID-19, there is a need to encourage researchers from countries other than the USA and China to participate in COVID 19 research to enhance the quality and quantity of scientific papers. This study also suggests that the researchers should expand their research collaboration with various countries to improve their scientific output on COVID-19.

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