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Sahoo, Sidhartha; Pandey, Shriram; and Mahapatra, R. K., "Understanding Characteristics of the 100 Most Influential Studies on Covid-19 (SARS-COV-2): A Bibliometric Analysis" (2020). *Library Philosophy and Practice (e-journal)*. 4945.

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**Understanding Characteristics of the 100 Most Influential Studies on Covid-19 (SARS-COV-2): A
Bibliometric Analysis**

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Abstract

Background

In present study, we aimed to identify and evaluate the trends of the 100 most-cited research articles on Covid-19 using bibliometric techniques.

Methods

Scopus online database hosted by Elsevier was used to extract relevant articles for this study. We have identified the top 100 research papers on Covid-19 published across the globe based on their citations data. Further analysis was made to find the countries of origin, journal wise distribution, author cluster network, keyword analysis and inter-citation map to understand and to establish the links among them.

Results

The T100 most cited articles were published between January-August, 2020 and their citations ranged from 304 to 5295. The T100 articles were contributed by 24 countries, with more than half is originated from China (n=63). Scientific publications originated from china received highest citations (55,688) followed by USA (13,996) and Hong Kong (9,501). Although 'New England Journal of Medicine' published the most papers (n=15) with the highest impact factor value of (74.699) but studies published in 'The Lancet' has received highest citations (n=18,431). The top five journals hold 44% of these influential studies. The Tongji medical college, Huazhong University of science & technology, Wuhan, China is the top institution with the most T100 articles in the field of Covid-19.

Conclusions

We analyzed the 100 most-cited articles in the field of Covid-19. China and USA are the dominant countries in terms of the number of T100 articles, scientists and institutions. Scientific publications originated from China also had the highest mean number of citations. The leading institutions with the most productive articles were Tongji medical college, Jin yin-tan hospital, Tsinghua university school of medicine (China) and University of North Carolina (US). The study authored by Huang C on “Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China” has received maximum citations (5295).

Keywords: Covid-19, SARS-COV-2, Citation pattern, Epidemic, Bibliometric analysis

Introduction

Citations are the key indicators to measure the quality, authorship and influence of an individual paper (Aksnes et al., 2019). Citation analysis measures the scientific performances of literature at a relatively low financial cost (Garfield, 1979). Citations indicators are now widely accepted and broadly applied to evaluate most-cited articles in different research domain. Garfield publication entitled "Highly Cited Works in Mathematics" in 1973 considered as classic paper which has given a depth insight to evaluate the highly cited papers. Citations values of a scholarly communication are being used by researchers to position their research work (Mansourizadeh & Ahmad, 2011). Citation-based approaches can reveal the dynamics of scientific activities and conveys foresight into emerging trends (Chen & Song, 2019). The spread of COVID-19 virus has created unprecedented chaos and posed one of the greatest threats before the survival of the human race. The global scientific communities have responded to the crises and coordinated effort is made to containing the spread of this epidemic & provides optimal care to those affected by the disease (WHO, 2020). Research published on covid-19 in many scientific journals in very short periods has increased tremendously. As per Scopus database, there were 43,723 research documents published on coronavirus disease in just eight months into the outbreak of the epidemic (during 01 January to 31 August 2020). However, we found that

there is a lack of comprehensive studies that provide an overall evaluation of the most-cited papers on Covid-19. The purpose of the present study was to identify the 100 most-cited articles on Covid-19 and to analyze their characteristics and inter-citation network.

Literature Reviewed

Coronavirus research publications trends are scattered and lie with many domains including medical science, management, tourism, psychology, sociology and many more. These studies mainly dealt with a wide variety of concerns like Covid-19 impact and effect on community health and its relations with various diseases like diabetes, hypertension (Parohan et al., 2020). Others domain studies are mainly concerned with COVID-19 impact on the industry, tourism, socio-economic conditions and its relationship with lockdown, closed border (Owojaiye; Lau et al.; Nikola et al., 2020). Research progress on Coronavirus and COVID-19 significantly focused on virology, epidemiology, and infectious diseases among others. However, there seems to be gap in research areas related to public health, its governance, technology, and communication (Zhang & Shaw, 2020). The emergence of COVID-19 has had a significant impact in other fields, particularly the social science, technology, physical sciences and arts and sciences, not just among clinical professionals (medical science) (Ruiz-Real et al., 2020). Bibliometric studies on Coronavirus and Covid-19 mainly focused on citation pattern co-word or cluster studies or Visualization in general context (Nicola et al.; Shamsi et al.; Fonkou et al., 2020). However, there are only a few bibliometric studies conducted so far at the global level in the context of both Coronavirus and Covid-19. The year 2020 is the witness of rapid scientific publications on Covid-19 (Sahoo & Pandey, 2020). Researches conducted on top-cited papers on Coronavirus are rare mainly published during 1973 to 2016 and appeared with the most prominent source like 'Journal of Virology' and from the USA. The University of Hong Kong became the most productive institute which published the most number of highly cited articles (Ram & Nisha, 2020). Study has co-related the evolving research pattern of both Coronavirus

and Covid-19 and concluded that USA dominates in the research output, while most of the influential institutions are from China (Sahoo & Pandey, 2020). Top fifty cited papers on Covid-19 appeared in most reputed journals. The main focus of these papers was clinical/radiological aspect of Covid-19 rather than treatments/vaccines (El Hawary, 2020).

Therefore, our study aimed at filling this knowledge gap by examining the global research trends on Covid-19 pandemic based on a bibliometric analysis of most-cited 100 articles in the year 2020. The primary objectives of our study are i) to identify the top 100 most-cited articles on COVID-19 ii) to identify the sources that published the 100 most-cited papers iii) to visualize the network of prominent authors based on their citations values iv) to analyze the characteristics and inter-citation network of these influential studies.

Materials & Methods

SCOPUS online database hosted by Elsevier is used for this study. A well defined systematic approach was adopted to retrieve the top cited publications. The following structured search query was formulated and total of 43,723 published research documents were identified on Covid-19 during 01 January to 31 August 2020. This search yielded 43,723 results, were then sorted in descending order with respect to the citations count.

Search Query: ((TITLE-ABS-KEY(Covid-19) OR (Coronavirus) OR (Coronavirus disease 2019) OR (SARS-COV-2) OR (2019-nCov)) AND PUBYEAR > 2019 AND (EXCLUDE (DOCTYPE,"er"))

The identified records were further refined and datasets were fixed based on their relevancy. Duplicate and irrelevant records & documents type such as ‘erratum’ has excluded from the sample data. The final dataset of T100 most-cited articles was assessed and analyzed using VOSviewer tool (Van Eck & Waltman, 2010). Citations data for this study was obtained till 31 August 2020. The journals impact factor values were cross referenced with the 2020

edition of Journal Citation Reports (JCR). Visualization maps were created for understanding the characters and influence of these studies.

Results

The most influential manuscripts (T100) were identified out of 43,514 records retrieved from SCOPUS database. **Table 1** shows the list of these most cited articles. The citations ranged from 304 for Xiao et al. (“Evidence for Gastrointestinal Infection of SARS-CoV-2”) to 5,295 for Huang et al. (“Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China”). In total 75,747 number of citation received by these top 100 studies.

Table 1. The top 100 most-cited papers on Covid-19

Rank	First Author	Title	Source title	Citation Count
1	Huang C.	Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China	The Lancet	5295
2	Guan W.	Clinical characteristics of coronavirus disease 2019 in China	New England Journal of Medicine	3407
3	Wang D.	Clinical Characteristics of 138 Hospitalized Patients with 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China	JAMA - Journal of the American Medical Association	3162
4	Zhu N.	A novel coronavirus from patients with pneumonia in China, 2019	New England Journal of Medicine	2889
5	Chen N.	Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study	The Lancet	2712
6	Zhou F.	Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study	The Lancet	2623
7	Wu Z.	Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases from the Chinese Center for Disease Control and Prevention	JAMA - Journal of the American Medical Association	2051
8	Zhou P.	A pneumonia outbreak associated with a new coronavirus of probable bat origin	Nature	2051
9	Li Q.	Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia	New England Journal of Medicine	2020
10	Lu R.	Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding	The Lancet	1465
11	Chan J.F.-W.	A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster	The Lancet	1436
12	Hoffmann M.	SARS-CoV-2 Cell Entry Depends on ACE2 and TMPRSS2 and Is Blocked by a Clinically Proven Protease Inhibitor	Cell	1333
13	Yang X.	Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study	The Lancet Respiratory Medicine	1195
14	Xu Z.	Pathological findings of COVID-19 associated with acute respiratory distress syndrome	The Lancet Respiratory Medicine	1169
15	Van Doremalen N.	Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1	New England Journal of Medicine	1103
16	Holshue M.L.	First case of 2019 novel coronavirus in the United States	New England Journal of Medicine	1087
17	Wang M.	Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro	Cell Research	1063

18	Mehta P.	COVID-19: consider cytokine storm syndromes and immunosuppression	The Lancet	1023
19	Gautret P.	Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial	International Journal of Antimicrobial Agents	927
20	Wu C.	Risk Factors Associated with Acute Respiratory Distress Syndrome and Death in Patients with Coronavirus Disease 2019 Pneumonia in Wuhan, China	JAMA Internal Medicine	882
21	Wu F.	A new coronavirus associated with human respiratory disease in China	Nature	872
22	Cao B.	A trial of lopinavir-ritonavir in adults hospitalized with severe covid-19	New England Journal of Medicine	828
23	Liang W.	Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China	The Lancet Oncology	765
24	Zou L.	SARS-CoV-2 viral load in upper respiratory specimens of infected patients	New England Journal of Medicine	757
25	Rothe C.	Transmission of 2019-NCOV infection from an asymptomatic contact in Germany	New England Journal of Medicine	739
26	Wang C.	A novel coronavirus outbreak of global health concern	The Lancet	732
27	Ai T.	Correlation of Chest CT and RT-PCR Testing for Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases	Radiology	692
28	Chen H.	Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records	The Lancet	676
29	Wrapp D.	Cryo-EM structure of the 2019-nCoV spike in the prefusion conformation	Science	671
30	Bai Y.	Presumed Asymptomatic Carrier Transmission of COVID-19	JAMA - Journal of the American Medical Association	638
31	Wang W.	Detection of SARS-CoV-2 in Different Types of Clinical Specimens	JAMA - Journal of the American Medical Association	636
32	Corman V.M.	Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR	Eurosurveillance	627
33	Tang N.	Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia	Journal of Thrombosis and Haemostasis	626
34	Brooks S.K.	The psychological impact of quarantine and how to reduce it: rapid review of the evidence	The Lancet	620
35	Mao L.	Neurologic Manifestations of Hospitalized Patients with Coronavirus Disease 2019 in Wuhan, China	JAMA Neurology	582
36	Gorbalenya A.E.	The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2	Nature Microbiology	578
37	Wan Y.	Receptor recognition by the novel coronavirus from Wuhan: An analysis based on decade-long structural studies of SARS coronavirus	Journal of Virology	575
38	Wu J.T.	Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study	The Lancet	554
39	Gao J.	Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies	BioScience Trends	553
40	Ruan Q.	Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China	Intensive Care Medicine	551
41	Walls A.C.	Structure, Function, and Antigenicity of the SARS-CoV-2 Spike Glycoprotein	Cell	547
42	Shi H.	Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study	The Lancet Infectious Diseases	544
43	Richardson S.	Presenting Characteristics, Comorbidities, and Outcomes among 5700 Patients Hospitalized with COVID-19 in the New York City Area	JAMA - Journal of the American Medical Association	542
44	Lai C.-C.	Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges	International Journal of Antimicrobial Agents	532

45	Yao X.	In Vitro Antiviral Activity and Projection of Optimized Dosing Design of Hydroxychloroquine for the Treatment of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)	Clinical infectious diseases : an official publication of the Infectious Diseases Society of America	496
46	Dong E.	An interactive web-based dashboard to track COVID-19 in real time	The Lancet Infectious Diseases	490
47	Zhang J.-J.	Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan, China	Allergy: European Journal of Allergy and Clinical Immunology	488
48	Onder G.	Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy	JAMA - Journal of the American Medical Association	487
49	Grasselli G.	Baseline Characteristics and Outcomes of 1591 Patients Infected with SARS-CoV-2 Admitted to ICUs of the Lombardy Region, Italy	JAMA - Journal of the American Medical Association	473
50	Fang L.	Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection?	The Lancet Respiratory Medicine	472
51	Wolfel R.	Virological assessment of hospitalized patients with COVID-2019	Nature	471
52	Russell C.D.	Clinical evidence does not support corticosteroid treatment for 2019-nCoV lung injury	The Lancet	463
53	Lauer S.A.	The incubation period of coronavirus disease 2019 (CoVID-19) from publicly reported confirmed cases: Estimation and application	Annals of Internal Medicine	455
54	Remuzzi A.	COVID-19 and Italy: what next?	The Lancet	440
55	Hui D.S.	The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health-The latest 2019 novel coronavirus outbreak in Wuhan, China	International Journal of Infectious Diseases	432
56	Rothan H.A.	The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak	Journal of Autoimmunity	429
57	Dong Y.	Epidemiology of COVID-19 among children in China	Pediatrics	422
58	Chen T.	Clinical characteristics of 113 deceased patients with coronavirus disease 2019: Retrospective study	The BMJ	416
59	Wang C.	Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China	International Journal of Environmental Research and Public Health	414
60	Kampf G.	Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents	Journal of Hospital Infection	411
61	Shi S.	Association of Cardiac Injury with Mortality in Hospitalized Patients with COVID-19 in Wuhan, China	JAMA Cardiology	409
62	Qin C.	Dysregulation of Immune Response in Patients With Coronavirus 2019 (COVID-19) in Wuhan, China	Clinical infectious diseases : an official publication of the Infectious Diseases Society of America	405
63	Zheng Y.-Y.	COVID-19 and the cardiovascular system	Nature Reviews Cardiology	403
64	Guo Y.-R.	The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak- A n update on the status	Military Medical Research	397
65	Chung M.	CT imaging features of 2019 novel coronavirus (2019-NCoV)	Radiology	396
66	Andersen K.G.	The proximal origin of SARS-CoV-2	Nature Medicine	393
67	Varga Z.	Endothelial cell infection and endotheliitis in COVID-19	The Lancet	392
68	Guo T.	Cardiovascular Implications of Fatal Outcomes of Patients with Coronavirus Disease 2019 (COVID-19)	JAMA Cardiology	390
69	Grein J.	Compassionate use of remdesivir for patients with severe Covid-19	New England Journal of Medicine	379
70	Tang N.	Anticoagulant treatment is associated with decreased mortality in severe coronavirus disease 2019 patients with coagulopathy	Journal of Thrombosis and Haemostasis	379
71	Yan R.	Structural basis for the recognition of SARS-CoV-2 by full-length human ACE2	Science	375
72	Shen C.	Treatment of 5 Critically Ill Patients with COVID-19 with Convalescent Plasma	JAMA - Journal of the American Medical Association	373
73	Chen G.	Clinical and immunological features of severe and moderate coronavirus disease 2019	Journal of Clinical Investigation	369

74	Chan J.F.	Genomic characterization of the 2019 novel human-pathogenic coronavirus isolated from a patient with atypical pneumonia after visiting Wuhan	Emerging Microbes and Infections	366
75	Vaduganathan M.	Renin-angiotensin-aldosterone system inhibitors in patients with covid-19	New England Journal of Medicine	362
76	Yang J.	Prevalence of comorbidities and its effects in coronavirus disease 2019 patients: A systematic review and meta-analysis	International Journal of Infectious Diseases	356
77	Lu X.	SARS-CoV-2 infection in children	New England Journal of Medicine	356
78	Xu X.-W.	Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-CoV-2) outside of Wuhan, China: Retrospective case series	The BMJ	355
79	Klok F.A.	Incidence of thrombotic complications in critically ill ICU patients with COVID-19	Thrombosis Research	352
80	Chen Y.	Emerging coronaviruses: Genome structure, replication, and pathogenesis	Journal of Medical Virology	349
81	Lu H.	Outbreak of pneumonia of unknown etiology in Wuhan, China: The mystery and the miracle	Journal of Medical Virology	346
82	Lai J.	Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019	JAMA network open	346
83	Fang Y.	Sensitivity of chest CT for COVID-19: Comparison to RT-PCR	Radiology	344
84	Li R.	Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2)	Science	344
85	Sohrabi C.	World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19)	International Journal of Surgery	343
86	Liu Y.	The reproductive number of COVID-19 is higher compared to SARS coronavirus	Journal of Travel Medicine	343
87	Li Y.-C.	The neuroinvasive potential of SARS-CoV2 may play a role in the respiratory failure of COVID-19 patients	Journal of Medical Virology	341
88	Emanuel E.J.	Fair allocation of scarce medical resources in the time of covid-19	New England Journal of Medicine	341
89	Xu X.	Evolution of the novel coronavirus from the ongoing Wuhan outbreak and modeling of its spike protein for risk of human transmission	Science China Life Sciences	341
90	Jin Y.-H.	A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version)	Military Medical Research	335
91	Young B.E.	Epidemiologic Features and Clinical Course of Patients Infected with SARS-CoV-2 in Singapore	JAMA - Journal of the American Medical Association	328
92	Liu J.	Hydroxychloroquine, a less toxic derivative of chloroquine, is effective in inhibiting SARS-CoV-2 infection in vitro	Cell Discovery	326
93	Bhatraju P.K.	COVID-19 in critically ill patients in the Seattle region-Case series	New England Journal of Medicine	326
94	To K.K.-W.	Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study	The Lancet Infectious Diseases	325
95	Sheahan T.P.	Comparative therapeutic efficacy of remdesivir and combination lopinavir, ritonavir, and interferon beta against MERS-CoV	Nature Communications	321
96	Zhang Y.	Coagulopathy and antiphospholipid antibodies in patients with covid-19	New England Journal of Medicine	315
97	Zhang W.	Molecular and serological investigation of 2019-nCoV infected patients: implication of multiple shedding routes	Emerging Microbes and Infections	314
98	Hollander J.E.	Virtually perfect? Telemedicine for covid-19	New England Journal of Medicine	313
99	Ong S.W.X.	Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) from a Symptomatic Patient	JAMA - Journal of the American Medical Association	306
100	Xiao F.	Evidence for Gastrointestinal Infection of SARS-CoV-2	Gastroenterology	304

The inter-citation network of highly cited T100 articles on Covid-19 is depicted in **Figure 1**.

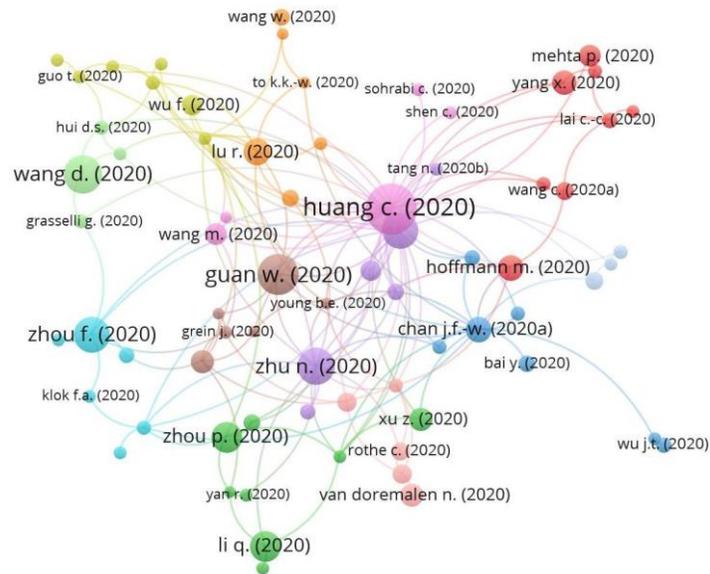


Figure 1. Represents the inter-citation networks of most cited 100 articles on covid-19

The analysis of the literature on Covid-19 shows that the China ranked top with the greatest number of publications (n=63) followed by United States of America (n=27) and United Kingdom (n=13) publications. Results indicate that the T100 cited articles were altogether contributed by 26 countries. Scientific publications originated from china received highest citations (55,688) followed by USA (13,996) and Hong Kong (9,501). Other prominent countries which are significantly contributed in these research studies are Hong Kong (n=10), Germany (n=9, citation- 5313), Netherlands (n=5, citation- 2628), Italy (n=5, citation- 2211), France(n=4, citation- 2480), Switzerland(n=4, citation- 1807) and Singapore(n=4, citation- 1445) .

The 100 most influential papers were scattered across 44 journals with the number of manuscripts per journal ranging from 1 to 15. Only 18 journals have published two or more of those articles whereas remaining journals are hold single publication. Journals published with four or more articles along with impact factor values shown in **Table 2**. Although ‘The New England Journal of Medicine’ published the most papers (n = 15), with highest impact factor of (74.699) but studies published in ‘The Lancet’ has received highest citations (n=18,431). The top

five journals hold 44% of these influential studies. Most of these influential studies are published in well qualified journal with significant higher value of impact factor.

Table 2. Journals with four or more articles in the top 100.

Journal Title	NP	TC	ACP	JIF as of 2019
The New England Journal of Medicine	15	15222	1014.80	74.699
The Lancet	13	18431	1417.77	60.392
JAMA - Journal of the American Medical Association	10	8996	899.60	45.54
Nature	3	3394	1131.33	42.778
The Lancet Respiratory Medicine	3	2836	945.33	25.094
Radiology	3	1432	477.33	7.931
Science	3	1390	463.33	41.845
The Lancet Infectious Diseases	3	1359	453.00	24.446
Journal of Medical Virology	3	1036	345.33	2.021
Cell	2	1880	940.00	38.637
International Journal of Antimicrobial Agents	2	1459	729.50	4.621
Journal of thrombosis and haemostasis	2	1005	502.50	4.157
Clinical infectious diseases	2	901	450.50	8.313
JAMA Cardiology	2	799	399.50	12.794
International Journal of Infectious Diseases	2	788	394.00	3.202
The BMJ	2	771	385.50	30.223
Military Medical Research	2	732	366.00	2.325
Emerging Microbes and Infection	2	680	340.00	5.776

The result revealed that the most publishing author Zhang I (n=6) has link strength of 285 received 6598 citations where as Chen H has published 6 papers but his link strength of 405 is highest in the network. The top 5 authors with the maximum contribution and largest total link strength were Zhang I (TP=6, TC=6598, TLS=285), Wang W(TP=6, TC=6118, TLS=206), Wang Y(TP=6, TC=6045, TLS=139), Chen H (TP=6, TC=5845, TLS=405) and Drost C(TP=6, TC=4180, TLS=298). Our purpose is not to rank authors; rather, we attempt to identify the most active researchers in order to understand their contribution towards the growth of the field. The cluster of author network map is displayed in **Figure 2**.

Co-occurrence of keywords analysis using VOSviewer tool is conducted and the results indicated the key concepts that have been explored by researchers in these 100 most-cited articles (Sahoo & Pandey, 2020). The research focus of these top 100 papers were found to be

mainly clinical characteristics of the epidemic, early transmission, infection, diagnosis, experimental treatments and care. Results of clusterwise keywords analysis is shown in **Figure 3**.

Discussions

In this study, we identify, rank and characterize the top 100 most cited research articles on Covid-19. The quantitative information about active authors, prominent institutions and core journals that published these influential studies was also provided. Usually an article received more citations with increasing age, and longer citable period. However, in our analysis, reveals that the number of research articles increased tremendously in this field in the last eight months. The domain has received the attention of the global scientific communities due to the magnitude of impact on public health and the rapid spread of the disease. COVID-19 has not only impacted hugely on global health, businesses but also disrupted the world economics (Haleem et al., 2020).

Citation map of top 100 studies on covid-19 is depicted in Figure 1. The citations count of an article partly depends on the early publication of the article, as citations accumulate over the years. However, we observed these papers are received huge citations in a very short time. This unusual growth may be attributed due to the novelty of these studies and the global impact of the disease. Publishing in open access platform has definitely generated wider visibility of these works and the knowledge being shared among the global research communities actively engaged in covid-19 pandemic.

Country wise distribution analysis indicated that the China has contributed maximum research publications (n=63) followed by United States of America (n=27) and United Kingdom (n=13). Scientific publications originated from china received highest citations (55688) followed by USA (13996) and Hong Kong (9501). Although scientific publications originated from the China had received highest citations but research studies from Hong Kong received highest

average citation per paper (950.10). Overall 26 countries together contributed to the top 100 most cited articles.

Of the total T100 articles, the leading institutions with the most productive articles were (Tongji medical college, Huazhong university of science and technology, Wuhan, China), (Jin yin-tan hospital, Wuhan, China), (Tsinghua university school of medicine, Beijing, China) and University of North Carolina, United States.

This finding illustrates the inverse correlation between average citations per year since publication and article age. It was a surprise to see such a trend and phenomenal growth of citations for younger publications.

The 100 most influential papers were scattered across 44 journals with the number of manuscripts per journal ranging from 1 to 15. Only 18 journals published 2 or more papers whereas remaining 26 sources hold single publication each. Although 'The New England Journal of Medicine' published the most papers ($n = 15$), with highest impact factor of (74.699) but studies published in 'The Lancet' has received highest citations ($n=18,431$). The top five journals hold 44% of these influential studies. Most of these influential studies are published in well qualified journal with significant higher value of impact factor. The range of impact factor values for these sources varies from 2.021 to 74.699.

Authorship analysis was performed to have better understanding of research collaboration among the scientific community. Out of 732 authors only 127 authors having minimum 2 publications are considered for creating cluster network and displayed in **Figure 2**. Each node in the graph presents an author, the size of the node depicts number articles the author has published, and the connection indicates cooperative relationship among these authors. From the figure, it can be seen that the most prolific authors are usually located in the core of the network and the distance between them is shortest. Each cluster of authors is distinguished by different

medical college, Jin yin-tan hospital, Tsinghua university school of medicine (China) and University of North Carolina (USA). The study authored by Huang C on “Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China” has received maximum citations of 5,295. The study presented an outlook to T100 top research papers which is limited to the citation data extracted from Scopus database. Future studies may be conducted by considering other citation databases like PubMed, WoS and Dimesion Data. An altemtrics study may be carried out to see the correlation between citation and altemtrics score. Study revealed several interesting findings and results of the study may be taken as pointer for the further bibliometric study on SARS-COV-2.

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