The top 100 most cited articles on COVID-19

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ABSTRACT

Purpose: *The purpose of this study was to identify the 100 most cited publications focusing on COVID-19 to provide readers with useful historical information on current relevant research.*

Methods: *A search of all databases and journals accessible in Elsevier's Scopus was performed on May 13th, 2020. The document search was performed using query "COVID-19," yielding 6,693 results. A similar search was performed using Thomson Reuter's Web of Science, yielding 2,593 documents and fewer citations. The top 100 most cited papers were identified, and data were extracted. All references contained within the top 100 articles were collected. Statistical analysis was performed using R-Studio and Bibliometrix.*

Results: *The top 100 most cited articles were published in 50 different journals from over 25 countries. The most cited article is "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China" by Huang et al., published in* The Lancet *with 1184 citations. Included are a list of the top 100 most cited articles, the most cited authors, the top five journals these publications most frequently appeared in, the most contributing countries, the top institutional affiliations, and the top international collaborations of the top 100 most cited publications on COVID-19.*

Conclusion: *In this study, the top 100 most cited works regarding COVID-19 have been identified and analyzed. This study will serve as a historical reference for future research. This study will also provide an educational guide to facilitate effective evidence-based medical research and offer insight into the developments of COVID-19 research.*

Keywords: Scientometric, Bibliometric, COVID-19, Coronavirus

INTRODUCTION

The severe acute respiratory syndrome coronavirus (SARS-CoV-2), also known as "COVID-19," has been a global tragedy in 2020. In December 2019, a series of pneumonia cases of unknown cause, clinically resembling a viral pneumonia, emerged in Wuhan, Hubei, China. Deep sequencing analysis found that SARS-CoV-2 was a relative of the viruses causing severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS); it affects the lower respiratory tract manifesting as pneumonia in humans.[2,3] The virus spreads faster than its two ancestors, but has lower mortality.[4] As of June 20, 2020, there were more than 8.7 million confirmed COVID-19 cases worldwide and more than 460,000 deaths.[5] The amount of published works about the virus is staggering, and medical professionals are struggling to keep up.

The aim of this study was to identify the 100 most cited publications focusing on COVID-19. Many medical specialties use bibliometrics to compile, publish, and review the most cited works within their respective fields.[6] Our literature search revealed that this has not been done for COVID-19. Analyzing the current status and trends can provide a basis for relevant COVID-19

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publications, provide readers useful information about the areas of research performed, provide an educational guide to facilitate effective evidence-based medical research, and provide unique insight into the developments in COVID-19 research.

Methods

A search of all databases and journals accessible in Elsevier's Scopus was performed on May 13th, 2020. The document search was performed using query "COVID-19," yielding 6,693 results. A similar search was performed using Thomson Reuter's Web of Science, yielding 2,593 documents and fewer citations. The top 100 most cited papers from Elsevier's database were identified, and data were extracted, collected, and sorted. All references contained within the top 100 articles were collected, sorted, and counted. Statistical analysis was performed using a combination of R-Studio and Bibliometrix.[1]

Results

Citations

All articles were published in 2020. The most cited article was "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China" by Huang C et al., published in *The Lancet* with 1184 citations (Table 1).[2] Of the 100 most cited articles, the number of citations ranged from 32 to 1184 (Table 1).

Authors, countries and affiliations

A total of 720 authors contributed to these published works, with reference dates ranging from 1937 to 2020. These articles were written by authors in various specialties, representing over 25 countries, and were published in 50 different journals. X. Li published the greatest number of the most cited articles (55). The top five countries contributing to the top 100 most cited articles were China, the United States, the United Kingdom, Germany, and Switzerland contributing 53, 17, 8, 5, and 4 articles, respectively. There were 172 reported institutional affiliations with the top 100 most cited articles. Figure 1 illustrates the institutions affiliated with greater than or equal to 10 of the 100 most cited publications. Zhongnan Hospital of Wuhan University is affiliated with the most articles (37).

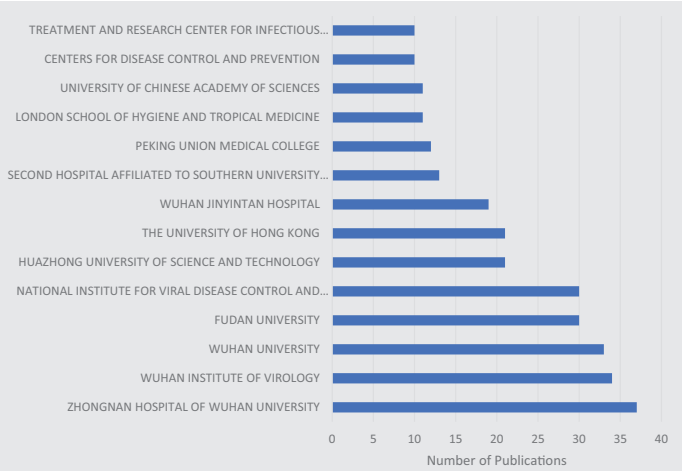

Figure 1. Top affiliations associated with greater than or equal to 10 articles.

Collaborations and sponsors

A total of 32 country to country collaborations were identified, with the most frequent collaboration in the top 100 most cited being between China and the United States. Fifty-three articles had funding sponsors. The top funding sponsors were the National Natural Science Foundation of China which sponsored 11 articles, followed by the Chinese Academy of Medical Sciences, the Chinese Academy of Sciences, and the National Basic Research Program of China, which each sponsored 10 articles.

Journal of publication

The top five journals were (1) *The Lancet* with 11 publications, (2) *The New England Journal of Medicine* with 9, (3) *Radiology* with 9, (4) *The Journal of the American Medical Association* with 6, and (5) the *Journal of Medical Virology* with 4 (Figure 2).

Discussion and conclusions

This study sought to identify and characterize the top 100 most cited articles regarding COVID-19 to gain insight into the most influential COVID-19 articles. As the world works to understand and control this virus, it is important to understand the current research

Table 1. The Top 100 Most Cited COVID-19 Articles

The Top 100 Most-Cited Articles For COVID-19				
Rank #	**Title**	**Authors**	**Source title**	**Total Citations**
1	Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China	Huang C. et al.	The Lancet	1184
2	A novel coronavirus from patients with pneumonia in China, 2019	Zhu N. et al.	New England Journal of Medicine	705
3	Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study	Chen N. et al.	The Lancet	641
4	Clinical characteristics of coronavirus disease 2019 in China	Guan W. et al.	New England Journal of Medicine	570
5	A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster	Chan J.F.-W. et al.	The Lancet	451
6	A pneumonia outbreak associated with a new coronavirus of probable bat origin	Zhou P. et al.	Nature	432
7	Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding	Lu R. et al.	The Lancet	379
8	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	Wu Z. et al.	JAMA-Journal of the American Medical Association	377
9	First case of 2019 novel coronavirus in the United States	Holshue M.L. et al.	New England Journal of Medicine	306
10	Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study	Zhou F. et al.	The Lancet	286
11	Transmission of 2019-NCOV infection from an asymptomatic contact in Germany	Rothe C. et al.	New England Journal of Medicine	235
12	Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro	Wang M. et al.	Cell Research	229
13	Pathological findings of COVID-19 associated with acute respiratory distress syndrome	Xu Z. et al.	The Lancet Respiratory Medicine	189
14	A new coronavirus associated with human respiratory disease in China	Wu F. et al.	Nature	168
15	SARS-CoV-2 viral load in upper respiratory specimens of infected patients	Zou L. el al.	New England Journal of Medicine	163
16	Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China	Liang W. et al.	The Lancet Oncology	151
17	Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records	Chen H. et al.	The Lancet	149

Table 1. The Top 100 Most Cited COVID-19 Articles (*Continued*)

The Top 100 Most-Cited Articles For COVID-19				
Rank #	**Title**	**Authors**	**Source title**	**Total Citations**
18	Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases	Ai T. et al.	Radiology	139
19	The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China	Novel Coronavirus Pneumonia Emergency Response Epidemiology Team	Zhonghua liu xing bing xue za zhi = Zhonghua liuxingbingxue Zazhi	138
20	SARS-CoV-2 Cell Entry Depends on ACE2 and TMPRSS2 and Is Blocked by a Clinically Proven Protease Inhibitor	Hoffmann M. et al.	Cell	131
21	Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies	Gao J. et al.	BioScience Trends	130
22	Presumed Asymptomatic Carrier Transmission of COVID-19	Bai Y. et al.	JAMA-Journal of the American Medical Association	123
23	Receptor recognition by the novel coronavirus from Wuhan: An analysis based on decade-long structural studies of SARS coronavirus	Wan Y. et al.	Journal of Virology	121
24	A Trial of Lopinavir-Ritonavir in Adults Hospitalized with Severe Covid-19	Cao B. et al.	The New England journal of medicine	119
25	CT imaging features of 2019 novel coronavirus (2019-NCoV)	Chung M. et al.	Radiology	112
26	Risk Factors Associated with Acute Respiratory Distress Syndrome and Death in Patients with Coronavirus Disease 2019 Pneumonia in Wuhan, China	Wu C. et al.	JAMA Internal Medicine	107
27	Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges	Lai C.-C. et al.	International Journal of Antimicrobial Agents	104
28	Clinical evidence does not support corticosteroid treatment for 2019-nCoV lung injury	Russell C.D. et al.	The Lancet	104
29	Evolution of the novel coronavirus from the ongoing Wuhan outbreak and modeling of its spike protein for risk of human transmission	Xu X. et al.	Science China Life Sciences	99
30	Importation and human-to-human transmission of a novel coronavirus in Vietnam	Phan L.T. et al.	New England Journal of Medicine	98
31	Genomic characterization of the 2019 novel human-pathogenic coronavirus isolated from a patient with atypical pneumonia after visiting Wuhan	Chan J.F.-W. et al.	Emerging Microbes and Infections	92
32	Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study	Shi H. et al.	The Lancet Infectious Diseases	90
33	Time Course of Lung Changes On Chest CT During Recovery From 2019 Novel Coronavirus (COVID-19) Pneumonia	Pan F. et al.	Radiology	90

(*continued*)

Table 1. The Top 100 Most Cited COVID-19 Articles (*Continued*)

The Top 100 Most-Cited Articles For COVID-19				
Rank #	**Title**	**Authors**	**Source title**	**Total Citations**
34	Emerging coronaviruses: Genome structure, replication, and pathogenesis	Chen Y. et al.	Journal of Medical Virology	89
35	Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents	Kampf G. et al.	Journal of Hospital Infection	87
36	Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan, China	Zhang J.-J. et al.	Allergy: European Journal of Allergy and Clinical Immunology	84
37	A novel coronavirus emerging in China-Key questions for impact assessment	Munster V.J. et al.	New England Journal of Medicine	81
38	COVID-19: consider cytokine storm syndromes and immunosuppression	Mehta P. et al.	The Lancet	79
39	COVID-19 and Italy: what next?	Remuzzi A. et al.	The Lancet	78
40	Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection?	Fang L. et al.	The Lancet Respiratory Medicine	77
41	Cross-species transmission of the newly identified coronavirus 2019-nCoV	Ji W. et al.	Journal of Medical Virology	70
42	Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China	Ruan Q. et al.	Intensive Care Medicine	70
43	The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application	Lauer S.A. et al.	Annals of internal medicine	69
44	A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version)	Jin Y.-H. et al.	Military Medical Research	68
45	Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China	Wang W. et al.	Journal of Medical Virology	67
46	Sensitivity of Chest CT for COVID-19: Comparison to RT-PCR	Fang Y. et al.	Radiology	65
47	Drug treatment options for the 2019-new coronavirus (2019-nCoV)	Lu H.	BioScience Trends	65
48	Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients [Directives concrètes à l'intention des équipes de soins intensifs et d'anesthésiologie prenant soin de patients atteints du coronavirus 2019-nCoV]	Wax R.S. et al.	Canadian Journal of Anesthesia	63
49	An interactive web-based dashboard to track COVID-19 in real time	Dong E. et al.	The Lancet Infectious Diseases	62
50	COVID-19 and the cardiovascular system	Zheng Y.-Y. et al.	Nature Reviews Cardiology	61
51	Molecular and serological investigation of 2019-nCoV infected patients: implication of multiple shedding routes	Zhang W. et al.	Emerging Microbes and Infections	61

Table 1. The Top 100 Most Cited COVID-19 Articles (*Continued*)

The Top 100 Most-Cited Articles For COVID-19				
Rank #	**Title**	**Authors**	**Source title**	**Total Citations**
52	Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection	Bernheim A. et al.	Radiology	60
53	Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy	Onder G. et al.	JAMA-Journal of the American Medical Association	60
54	Critical Care Utilization for the COVID-19 Outbreak in Lombardy, Italy: Early Experience and Forecast during an Emergency Response	Grasselli G. et al.	JAMA-Journal of the American Medical Association	60
55	The reproductive number of COVID-19 is higher compared to SARS coronavirus	Liu Y. et al.	Journal of Travel Medicine	59
56	Virtually Perfect? Telemedicine for Covid-19	Hollander J.E. et al.	The New England journal of medicine	58
57	Return of the coronavirus: 2019-nCoV	Gralinski L.E. et al.	Viruses	57
58	Incubation period of 2019 novel coronavirus (2019- nCoV) infections among travellers from Wuhan, China, 20 28 January 2020	Backer J.A. et al.	Eurosurveillance	56
59	World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19)	Sohrabi C. et al.	International Journal of Surgery	55
60	Clinical and biochemical indexes from 2019-nCoV infected patients linked to viral loads and lung injury	Liu Y. et al.	Science China Life Sciences	51
61	CT imaging of the 2019 novel coronavirus (2019-NCoV) pneumonia	Lei J. et al.	Radiology	51
62	The neuroinvasive potential of SARS-CoV2 may play a role in the respiratory failure of COVID-19 patients	Li Y.-C. et al.	Journal of Medical Virology	50
63	Fair Allocation of Scarce Medical Resources in the Time of Covid-19	Emanuel E.J. et al.	The New England journal of medicine	50
64	Dysregulation of immune response in patients with COVID-19 in Wuhan, China	Qin C. et al.	Clinical infectious diseases: an official publication of the Infectious Diseases Society of America	50
65	Coronavirus Disease 2019 (COVID-19): A Perspective from China	Zu Z.Y. et al.	Radiology	49
66	Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020	Riou J. et al.	Eurosurveillance	49
67	Chloroquine and hydroxychloroquine as available weapons to fight COVID-19	Colson P. et al.	International Journal of Antimicrobial Agents	46
68	Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts	Hellewell J. et al.	The Lancet Global Health	46
69	Emerging 2019 novel coronavirus (2019-NCoV) pneumonia	Song F. et al.	Radiology	46

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Table 1. The Top 100 Most Cited COVID-19 Articles (*Continued*)

The Top 100 Most-Cited Articles For COVID-19				
Rank #	**Title**	**Authors**	**Source title**	**Total Citations**
70	Structural basis for the recognition of SARS-CoV-2 by full-length human ACE2	Yan R. et al.	Science	44
71	The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak	Rothan H.A. et al.	Journal of Autoimmunity	43
72	Functional assessment of cell entry and receptor usage for SARS-CoV-2 and other lineage B betacoronaviruses	Letko M. et al.	Nature Microbiology	42
73	Therapeutic options for the 2019 novel coronavirus (2019-nCoV)	Li G. et al.	Nature reviews. Drug discovery	42
74	Chest CT findings in 2019 novel coronavirus (2019-NCoV) infections from Wuhan, China: Key points for the radiologist	Kanne J.P.	Radiology	42
75	High expression of ACE2 receptor of 2019-nCoV on the epithelial cells of oral mucosa	Xu H. et al.	International Journal of Oral Science	40
76	How will country-based mitigation measures influence the course of the COVID-19 epidemic?	Anderson R.M. et al.	The Lancet	40
77	Covid-19-Navigating the uncharted	Fauci A.S. et al.	New England Journal of Medicine	39
78	The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak-An update on the status	Guo Y.-R. et al.	Military Medical Research	39
79	Pulmonary Pathology of Early-Phase 2019 Novel Coronavirus (COVID-19) Pneumonia in Two Patients With Lung Cancer	Tian S. et al.	Journal of Thoracic Oncology	38
80	Coronavirus Disease 2019 (COVID-19) in Italy	Livingston E. et al.	JAMA	38
81	COVID-19: what is next for public health?	Heymann D.L. et al.	The Lancet	38
82	Defining the epidemiology of Covid-19-Studies needed	Lipsitch M. et al.	New England Journal of Medicine	37
83	Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019	Lai J. et al.	JAMA network open	37
84	Case of the index patient who caused tertiary transmission of coronavirus disease 2019 in Korea: The application of lopinavir/ritonavir for the treatment of COVID-19 pneumonia monitored by quantitative RT-PCR	Lim J. et al.	Journal of Korean Medical Science	37
85	Angiotensin receptor blockers as tentative SARS-CoV-2 therapeutics	Gurwitz D.	Drug Development Research	37
86	Prevalence of comorbidities and its effects in coronavirus disease 2019 patients: A systematic review and meta-analysis	Yang J. et al.	International Journal of Infectious Diseases	36
87	Convalescent plasma as a potential therapy for COVID-19	Chen L. et al.	The Lancet Infectious Diseases	36
88	Characteristics and Outcomes of 21 Critically Ill Patients with COVID-19 in Washington State	Arentz M. et al.	JAMA-Journal of the American Medical Association	36

Table 1. The Top 100 Most Cited COVID-19 Articles (*Continued*)

The Top 100 Most-Cited Articles For COVID-19				
Rank #	**Title**	**Authors**	**Source title**	**Total Citations**
89	Potent binding of 2019 novel coronavirus spike protein by a SARS coronavirus-specific human monoclonal antibody	Tian X. et al.	Emerging Microbes and Infections	36
90	Positive RT-PCR Test Results in Patients Recovered from COVID-19	Lan L. et al.	JAMA-Journal of the American Medical Association	35
91	Enteric involvement of coronaviruses: is faecal–oral transmission of SARS-CoV-2 possible?	Yeo C. et al.	The Lancet Gastroenterology and Hepatology	35
92	Online mental health services in China during the COVID-19 outbreak	Liu S. et al.	The Lancet Psychiatry	34
93	Pathogenicity and transmissibility of 2019-nCoV—A quick overview and comparison with other emerging viruses	Chen J.	Microbes and Infection	34
94	The COVID-19 epidemic	Velavan T.P. et al.	Tropical Medicine and International Health	34
95	Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China	Li B. et al.	Clinical Research in Cardiology	33
96	Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020	Mizumoto K. et al.	Eurosurveillance	33
97	Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China	Wang C. et al.	International Journal of Environmental Research and Public Health	33
98	The SARS, MERS and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned?	Peeri N.C. et al.	International journal of epidemiology	33
99	COVID-19: Gastrointestinal Manifestations and Potential Fecal–Oral Transmission	Gu J. et al.	Gastroenterology	32
100	Mental health care for medical staff in China during the COVID-19 outbreak	Chen Q. et al.	The Lancet Psychiatry	32

landscape. Although the knowledge about COVID-19 is rapidly expanding and changing, this study offers important quantitative information to understand the current progress and trends of COVID-19 research. Furthermore, the most prolific authors and countries were identified to encourage inter-country collaboration among the top active researchers found in this study. The top 100 articles were published in 50 different journals, reflecting the multidisciplinary nature and complexity of this disease. To our knowledge, this is the first bibliometric analysis on COVID-19. The results of our study showed that COVID-19 research is unprecedented with more than 6500 publications in under a year. Moreover, the top cited COVID-19 articles are important for future researchers to consider. This study will serve as a reference for COVID-19 research and an educational foundation for physicians and researchers.

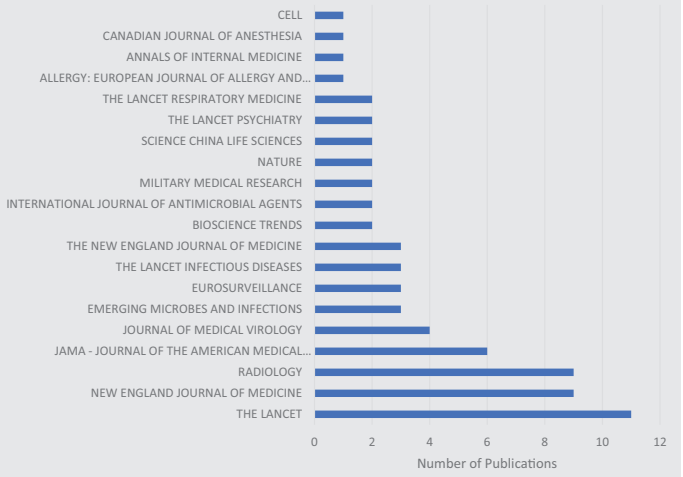

Figure 2. Top 20 journals.

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References

1. Aria M, Cuccurullo C. Bibliometrix: An R-tool for comprehensive science mapping analysis. J Informetr 2017;11(4): 959–975.
2. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020 Jan 30;395(10223):497–506.
3. Sohrabi C, Alsafi Z, O'Neill N, et al. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). Int J Surg 2020 Apr;76:71–76.
4. Singhal T. A review of coronavirus disease-2019 (COVID-19). Indian J Pediatr 2020 Apr;87(4):281–286.
5. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. Lancet Infect Dis; c2020 [cited 2020 May 15]. Available from: https://coronavirus.jhu.edu/us-map
6. Mohammed MF, Marais O, Qureshi AI, et al. The top 100 most cited articles in stroke imaging: a bibliometric analysis. Curr Probl Diagn Radiol 2018 May–Jun;47(3):161–167.