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Original Article

Global Publications on Covid-19 and Neurosciences: A Bibliometric Assessment during 2020-21

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ABSTRACT

Background: Covid-19 is a significant global health burden. The pulmonary morbidity and mortality of Covid-19 is well described, however, there is mounting evidence of neurological manifestations of SARS-CoV-2, which may be of paramount significance. This paper provides a bibliometric assessment of global literature of the peripheral and central neurological manifestations of Covid-19, using bibliometric methods. **Methods:** The study downloaded publications on this topic from the Scopus database using a well-defined research strategy. The search strategy was initially based on using different keywords related to Covid-19 in "Keyword" and "Title" search tags of Scopus database. The search was subsequently restricted to "Neurosciences" subject, yielding 5245 global records. **Results:** The 5245 global publications were published on 'Covid-19 and Neurosciences" as covered in Scopus database and they have received 5245 citations, averaging 13.46 citations per paper. Of these 5245 publications, 24.54% (1287) received external funding support from 150+ agencies and averaged 20.17 citations per paper. 160 countries participated in global research on this topic, with USA, U.K. and Italy contributing the largest publication share (26.43%, 12.14% and 10.51%) and China (23.8 and 1.78), Spain (9.13 and 0.68) and Italy (8.56 and 0.64) registering the highest citation impact, based on citations per paper and relative citation index. "Adults", among population age groups, contributed the largest share (30.31%), followed by "Aged" (9.48%), "Middle Aged" (9.02%), "Children"(4,73%) and "Adolescents" (2.71%). "Stroke", "Multiple Sclerosis" and "Headache" among type of neurological diseases impacted by Covid-19, contributed the largest global publication share (6.31%, 6.22% and 6.06%), followed by "Seizure", "Parkinson's Disease", Cerebrovascular Accident", "Anosmia", "Guillain-Barre Syndrome" and "Epilepsy" (from 4.39% to 5.62%), etc. "Clinical Studies", among various types of research, contributed the largest publication share (29.38%) in total output impacted by Covid-19, followed by "Complications" (16.03%), "Treatment" (13.99%), "Pathophysiology" (12.18), "Risk Factors"(10.79%), "Epidemiology" (9.38%) and "Genetics". Among participating organizations, Harvard Medical School, USA, University of Toronto, Canada and INSERM, France contributed the largest output (with 142, 101 and 99 papers) and University of Cambridge, U.K. (72.97 and 5.46), King's College London, U.K. (49.97 and 3.74), University College London, U.K. (47.58 and 3.56) registered the largest citation impact. Among participating authors, J. Sterer (24 papers), F.A. Scorza (20 papers) and E. Moro (14 papers) contributed the largest number of papers and Z. Liu (169.7 and 12.7), M.L.R. Neto (54.92 and 4.11) and G. Tsivgoulis (45.54 and 3.41) registered the highest citation impact. Among journals participating on this theme, *Psychiatry Research* (311 papers), *The Lancet Psychiatry* (175 papers) and *Frontiers in Neurology* (172 papers) contributed the largest number of papers and *Brain, Behavior and Immunity* (61.35), *The Lancet Psychiatry* (54.58) and *Nature Human Behavior* (44.37) registered the largest citation impact per paper. **Conclusion:** This paper evaluates the rapidly evolving literature on the neurological manifestations of Covid-19, which will help to inform and improve decision-making among physicians treating Covid-19 and scholars conducting research on this area. It will also aid in the recognition of significant extra-pulmonary manifestations of the disease among attending front-line clinicians and consulting neurologists and also help them in understanding the pandemic's broader impact on chronic disease management.

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INTRODUCTION

Covid-19 was officially declared as a global pandemic by WHO on 11 March 2020. Since then, the pandemic and its outbreak have radically affected the social, political and medical landscape. WHO reported 239,437,517 global confirmed cases and 4,879,235 global deaths in more than 200 countries as a result of Covid-19 on 15 October 2021.[1] Covid-19 is considered as a significant global health burden. Although the pulmonary morbidity and mortality of Covid-19 is well discussed in literature, however, there is mounting evidence of neurological manifestations of SARS-CoV-2, which may be of paramount significance.[2,3] The neurological manifestations of Covid-19 can manifest either during the acute phase or as a later post-infectious phenomena. The various implicated neuron-pathological effects of SARS-CoV-2 infection that are discussed in the global literature includes: (i) direct viral injury, (ii) neural or vascular pathology arising secondary to a hyper-inflammatory state; (iii) vasculopathy/coagulopathy; (iv) post-infectious autoimmune and (v) neurological consequence of severe illness (sepsis, hypoxia).[4] Both central (CNS) and peripheral nervous system (PNS) manifestations are there because of Covid-19. Examples of (i) Central Nervous System neurological manifestations include dizziness, headache, cerebrovascular disease, encephalopathy/delirium, encephalitis, acute disseminated encephalomyelitis, acute necrotising hemorrhagic encephalopathy, seizures, ischemic stroke, intra-cerebral hemorrhage, encephalo-myelitis, and acute myelitis and (ii) peripheral nervous system include hypoguesia and hyposmia, Guillain-Barre syndrome, myalgia, Bell's palsy, Brachial plexopathy and skeleton muscle manifestations such as rhabdomyolysis.[5,6]

Literature Review

Although a number of bibliometric studies have been undertaken on Coronavirus and Covid-19 research,[7,8] but only few bibliometric studies exists in neurological implications of Covid-19. Among available

studies, Kiraj[9] analyzed the global outputs (459) of Covid-19 in the field of neuroscience through bibliometric methods, using Web of Science database. The top 5 countries that produced the highest number of publications were the USA (with 30.2% share), Italy (23.9% share), U.K (12.2% share), China (10.6% share), and Germany (9.3% share). The journals that produced the highest number of publications were *Brain Behavior and Immunity, Journal of Neurology, Neurological Sciences, Nature Human Behavior and Acta Neurochirurgica*. The most commonly investigated topics and keywords were stroke, encephalitis, depression, mental health, stress, neurosurgery, Parkinson's disease, Guillain-Barre syndrome, multiple sclerosis, anxiety and headache. Rogers, Watson and Badenoch[10] conducted a systematic review and meta-analysis based on selected studies on the neurological and neuropsychiatric consequences of Covid-19 with focus on finding the key methodological characteristics of literature and the prevalence of neurological and neuropsychiatric complications in patients with Covid-19 in observational or interventional studies using few databases from 1 January 2020 to 18 July 2020. Twenty neurological or neuropsychiatric manifestations were estimated by at least three studies, such that we included 147 studies (reporting on 99905 infected patients) in the meta-analysis. The most often studied symptoms were headache, myalgia, fatigue, anosmia, and dyspepsia. The most prevalent symptoms were anosmia, weakness, fatigue, dyspepsia, and myalgia. Sleep disorder, along with insomnia and sleep impairment were a term that were used in a number of studies.

Objectives

The objective of the present study is to analyze the peripheral and central neurological manifestations of Covid-19 research as reflected in global literature published during 2020-21. The specific objectives of the study are to study: (i) publication distribution by document source and type; (ii) overall bibliometric characteristics of the literature; (iii) the geographical distribution, (iv) subject-wise distribution and identification of sub-fields, important keywords and type of studies; (v) profile of leading organizations and authors; (vi) identification of most active sources and (vii) characterstics of high-cited papers.

Methodology

The study used the scientometric/bibliometric methods to analyze quantitatively and qualitatively the research output indexed in the Scopus database on this theme from the year December 2020 to 26 August 2021. The Scopus database was comprehensively searched on relevant publications on "Covid-19 and Neuroscience" using a well-defined search strategy shown below. A total of 5245 English documents were extracted from Scopus database. The metadata of the obtained records was exported from Scopus and saved in BIB File (.bib) format for final analysis. Bibliometrix and an R package (Biblioshiny) packages were used to perform comprehensive mapping of final publications data. Bibliometric aspects studied includes the year of publications, authors, region, subject areas, countries, institutions, journals, and funding agencies and extent of international collaboration.

TITLE ("Covid 19" or "2019 novel coronavirus" or "coronavirus 2019" or "coronavirus disease 2019" or "2019-novel CoV" or "2019 ncov" or covid 2019 or covid19 or "corona virus 2019" or ncov-2019 or ncov2019 or "nCoV 2019" or 2019-ncov or covid-19 or "Severe acute respiratory syndrome coronavirus 2" or "SARS-CoV-2") or KEY ("Covid 19" OR "2019 novel coronavirus" or "coronavirus 2019" or "coronavirus disease 2019" or "2019-novel CoV" or "2019 ncov" or covid 2019 or covid19 or "corona virus 2019" or ncov-2019 or ncov2019 or "nCoV 2019" or 2019-ncov or covid-19 or "Severe acute respiratory syndrome coronavirus 2" or "SARS-CoV-2") and (LIMIT-TO (SUBJAREA, "NEUR")).

Analysis and Results

Overall Characterstics

In all, 5245 publications are published on "Covid-19 and Neurosciences" as indexed in Scopus database. These 5245 publications received 70073 citations, averaging 13.36 citations per paper. Of the 5245 total publications, 1287 received external funding support from 150+ agencies. The 1287 (24.54% share in global total) funded publications received 25966 citations, averaging 20.17 citations per paper. The major funding agencies along with their output were: National Institutes of Health (293) papers, National Natural Science Foundation of China (130 papers), U.S. Department of Health and Human Services (125 papers), etc. Among 5245 publications, articles constituted the largest share (53.05%), followed by letters (20.69%), reviews (14.28%), notes (5.69%), editorials (5.04%), erratum (0.69%), conference paper (0.28%), short surveys (0.23), book chapters (0.05) and retracted (0.01).

Top 15 Countries

160 countries unevenly participated in global research on "Covid-19 and Neurosciences". The top 10 countries individually contributed 124 to 1571 papers each and together contributed 67.22% global publication shares and more than 100.0% global citations share. Among top 10 countries, the largest contribution is made by USA (with 26.43% global share), followed by U.K. (12.14% share), Italy (10.51% share), China (7.35% share), Germany, India and Canada (5.84%, 5.60% and 5.48% share each), Spain and France (4.98% and 4.12% share each), Brazil, Iran, Australia, Netherlands, Switzerland and Turkey (from 2.09% to 3.95% share each). On further analysis, it was observed that: (i) Four out of top 15 countries contributed more than average (397.67) of all 15 countries: USA (1571 papers), U.K. (722 papers), Italy (625 papers) and China (437 papers) and (ii) Three out of top 15 countries registered citations per paper and relative citation index higher than their group average (7.92 and 0.59): China (23.8 and 1.78), Spain (9.13 and 0.68) and Italy (8.56 and 0.64) (Table 1).

Figure 1 shows a map of co-authorship analysis that reveals the collaboration networks among countries working on "Covid-19 and Neuroscience" during pandemic. The USA leads with highest number of collaborative links (6147 linkages), followed by UK (4042), Italy (4021), China (2489), Germany (2357), Canada (1812) and India (1493). Of all countries USA, Canada, UK, China, Italy, Germany and India represents the largest nodes in the map and they have also made the greatest number of collaborative linkages with other countries. There is a strong collaborative networks among the displaced countries, since almost all of them linked in the network. The strongest collaborations are between USA and U.K. (165 links), followed by Canada-USA (120 links), USA-China (115 links), USA-Italy (107 links), UK-Italy (97 links), USA-Germany (86 links), Germany- UK (83 links), Australia - USA (82 links) and USA-India (82 links).

Classification by Population Age Groups

On analyzing global research on this theme by population age groups, it was observed that the maximum focus of research was on "Adults" (with 30.31% publication share), followed by "Aged" (9.48%), "Middle Aged" (9.02%), "Children" (4, 73%) and "Adolescents" (2.71%). The publications in "Adolescents" group registered the highest citation impact per paper (54.49), followed by "Middle Aged" (24.19), "Aged" (21.15), "Adults" (19.01) and "Children" (13.68).

Classification by Type of Neurological Disease

The impact of Covid-19 on various neurological diseases is studied, as reflected in Table 2. Among neurological diseases, "Stroke", "Multiple Sclerosis" and "Headache" contributed the largest global publication

share (6.31%, 6.22% and 6.06%), followed by "Seizure", "Parkinson's Disease", Cerebrovascular Accident", "Anosmia", "Guillain-Barre Syndrome" and "Epilepsy" (from 4.39% to 5.62%), "Dementia", "Alzheimer's Disease", "Myalgia", "Encephalitis", "Cerebrovascular Disease", "Neuropathy" and "Psychosis" (from 2.27% to 3.16%) and seven other neurological diseases from 0.50% to 1.93%. In terms of impact, "Dyesgeusi" registered the highest citation impact per paper (39.88), followed by "Psychosis" (28.61), "Alzheimer Disease" (26.31), "Neuropathy" (24.37), "Epilepsy" (23.86), "Anosmia" (18.16), etc.

Table 1: Bibliometric Profile of Top 15 Countries on "Covid-19 and Neurosciences".

S.No	Name of the country	TP	TC	CPP	RCI	TCL
1	USA	1571	11138	7.09	0.53	6167
2	U.K.	722	5064	7.01	0.52	4042
3	Italy	625	5348	8.56	0.64	4021
4	China	437	10401	23.80	1.78	2489
5	Germany	347	2088	6.02	0.45	2357
6	India	333	1380	4.14	0.31	1493
7	Canada	326	1179	3.62	0.27	1812
8	Spain	296	2703	9.13	0.68	2056
9	France	245	1750	7.14	0.53	1617
10	Brazil	235	1557	6.63	0.50	1274
11	Iran	215	1685	7.84	0.59	1292
12	Australia	211	934	4.43	0.33	1397
13	Netherlands	130	845	6.50	0.49	882
14	Switzerland	128	333	2.60	0.19	1051
15	Turkey	124	697	5.62	0.42	689
	Total of 15 countries	5945	47102	7.92	0.59	
	Global total	5245	70073	13.36	1.0	
	Share of top 15 countries in global total		67.22			

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index; TCL=Total collaborative linkages

Classification by Type of Studies

On classifying global publications on this theme by type of research (seven broad categories), it was observed that "Clinical Studies" accounts for the largest share (29.38%) in total output, followed by "Complications" (16.03%), "Treatment" (13.99%), "Pathophysiology" (12.18), "Risk Factors"(10.79%), "Epidemiology" (9.38%) and "Genetics". In terms of impact, "Treatment" accounts for largest citation impact per paper (117.6), followed by "Genetics" (26.69), "Complications" (21.12), "Pathophysiology" (20.68), "Epidemiology"(20.15), "Risk Factors" (19.53) and "Clinical Studies" (17.68) (Table 3).

Important Keywords

The 37 Keywords (with comparatively higher frequency of appearance varying from 118 to 3595) have been identified from the literature and considered as significant as they throw some light on the trends of research on his theme. These 37 keywords are listed in Table 4. The largest frequency of occurrence (3595) was reported by keyword "Covid-19", followed by "Mental Health"(663), "Depression" (628), "Anxiety" (626), "Mental Disease" (460), "Neurological Disease"(384), "Multiple Scierosis" (324), "Headache" (316),"Cerebrovascular Accidents" (291), etc.

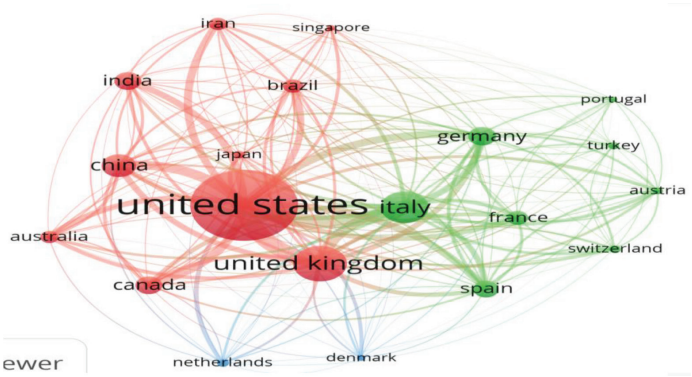

Figure 1: Collaboration Network Visualization of Countries.

Table 2: Classification of Global Literature on "Covid-19 and Neurosciences" by Type of Disease.

Synod	Type of Disease	TP	TC	CPP	Synod	Type of Disease	TP	TC	CPP
1	Stroke	331	4747	14.34	14	Cerebrovascular Disease	129	1053	8.16
2	Multiple Sclerosis	326	2888	8.86	15	Neuropathy	129	3144	24.37
3	Headache	318	5068	15.94	16	Psychosis	119	3405	28.61
4	Seizure	295	3405	11.54	17	Paralysis	101	1586	15.70
5	Parkinson's Disease	263	4662	17.73	18	Encephalopathy	78	1011	12.96
6	Cerebrovascular Accident	250	2374	9.50	19	Cognitive Defects	67	1007	15.03
7	Anosmia	240	4358	18.16	20	Attention Deficit Disorders	43	230	5.35
8	Guillain-Barre Syndrome	239	2397	10.03	21	Dyesgeusia	40	1595	39.88
9	Epilepsy	230	5488	23.86	22	Amy tropic Lateral Sclerosis	36	461	12.81
10	Dementia	166	1681	10.13	23	Ataxia	26	174	6.69
11	Alzheimer's Disease	163	4288	26.31		Global total	5245		
12	Myalgia	152	2442	16.07	14				
13	Encephalitis	142	2211	15.57	15				

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index

Table 3: Classification of Global Publication on "Covid-19 and Neurosciences" by Type of Research.

S.No	Type of Study	TP	TC	CPP	%TP
1	Clinical Studies	1541	27238	17.68	29.38
2	Epidemiology	492	9915	20.15	9.38
3	Pathophysiology	639	13216	20.68	12.18
4	Genetics	144	3844	26.69	2.75
5	Complications	841	17758	21.12	16.03
6	Risk Factors	566	11055	19.53	10.79
7	Treatment	734	86317	117.60	13.99
	Global total	5245			

TP=Total papers; TC=Total citations; CPP=Citations per paper

Table 4: Significant Keywords Appearing in Global Publications on "Covid-19 and Neurosciences".

S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency
1	Covid-19	3595	20	Distress Syndrome	181
2	Mental Health	663	21	Insomnia	177
3	Depression	628	22	Fatigue	176
4	Anxiety	626	23	Posttraumatic Stress	176
5	Mental Disease	460	24	Nervous System Disease	175
6	Neurological Disease	384	25	Brain Ischemia	163
7	Multiple Sclerosis	324	26	Brain Disease	163
8	Headache	316	27	Brain Hemorrhage	
9	Cerebrovascular Accident	291	28	Encephalitis	
10	Mental Stress	257	29	Sleep Disorder	155
11	Stroke	244	30	Myalgia	150
12	Angiotensin Converting Enzyme 2	242	31	Psychological Stress	148
13	Anosmia	238	32	Cytokine Storm	143
14	Dyspnea	236	33	Cognitive Defects	141
15	Seizure	221	34	Central Nervous System	136
16	Hypertension	222	35	Agues	118
17	Epilepsy	209	36	Cerebrovascular Disease	118
18	Parkinson's Disease	204	37	Neurological Complications	118
19	Gillian Bare Syndrome	194			

Top 20 Organizations

The top 20 organization individually contributed 49 to 143 papers and together contributed 25.83% (1355 papers) and 48.47% (33967) share respectively in global publications and citations. On further analysis, it was observed that: (i) Six organizations contributed papers higher than their group average (67.75): Harvard Medical School, USA (142 papers), University of Toronto, Canada (101 papers), INSERM, France (99 papers), King's College, London, U.K. (94 papers), University College London, U.K. (85 papers) and University of Oxford, U.K. (80 papers), and (ii) Seven organizations registered citation per paper and relative citation index above their group average (25.07 and 1.88): University of Cambridge, U.K. (72.97 and 5.46), King's College London, U.K. (49.97 and 3.74), University College London, U.K. (47.58 and 3.56), University of Melbourne, U.K. (42.76 and 3.20), University of Oxford, U.K. (38.96 and 2.92), Tongji Medical College, China (36,82 and 2.76) and University of British Columbia, Canada (31.41 and 2.35) (Table 5}.

Figure 2 depicts the collaborative linkages among top 20 organizations, and they are shown in different clusters represented by colors. The node/circle size represents the quantity of publications, and the line between the two nodes demonstrates the academic link between the two organizations. University of California, Harvard University, Stanford University, University of Michigan took the lead with highest number of links in one cluster. University of Oxford, U.K. leads in betweenness with (205.72), followed by University College London (168.98), University of California (158.58) among others.

Table 5: Bibliometric Profile of Top 20 Organizations in "Covid-19 and Neurosciences".

S.No	Name of the organization	TP	TC	CPP	RCI
1	Harvard Medical School, USA	143	1575	11.01	0.82
2	University of Toronto, Canada	101	2137	21.16	1.58
3	INSERM, France	99	1293	13.06	0.98
4	King's College London, U.K.	94	4697	49.97	3.74
5	University College London, U.K.	85	4044	47.58	3.56
6	University of Oxford, U.K.	80	3117	38.96	2.92
7	Sapienza University of Rome, Italy	69	1280	18.55	1.39
8	Massachusetts General Hospital, USA	66	780	11.82	0.88
9	University of Cambridge, U.K.	59	4305	72.97	5.46
10	Tehran University of Medical Sciences, Iran	56	551	9.84	0.74
11	University of Sao Paulo, Brazil	53	446	8.42	0.63
12	Imperial College, London, U.K.	53	1267	23.91	1.79
13	Tongji Medical College, China	51	1878	36.82	2.76
14	AP-HP Assistance Publique-Hopitaux de Paris, France	51	574	11.25	0.84
15	Universidad Complutense de Madrid, Spain	50	1026	20.52	1.54
16	University of British Columbia, Canada	49	1539	31.41	2.35
17	Icahn School of Medicine at Mount Sinai, USA	49	320	6.53	0.49
18	Brigham and Women's Hospital, USA	49	654	13.35	1.00
19	University of Melbourne, Australia	49	2095	42.76	3.20
20	Universitat degli studi di Milano, Italy	49	389	7.94	0.59
	Total of 20 organizations	1355	33967	25.07	1.88
	Global total	5245	70073	13.36	1.00
	Share of top 20 organizations in global total	25.83	48.47		

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index

Top 20 Authors

28082 authors participated unevenly in global research on "Covid-19 and Neurosciences": The top 20 authors individually contributed 10 to 24 papers each and together contributed 4.63% (243) and 7.66% (5368) shares in global publications and citations. On further analysis, it was observed that: (i) Five authors contributed papers higher than their group average (12.15): J. Sterer (24 papers), F.A. Scorza (20 papers), E. Moro (14 papers), M.L.R. Neto and G. Tsivgoulis (13 papers each); (ii) Four authors registered citation per paper and relative citation index above their group average (22.09 and 1.65): Z.Liu (169.7 and 12.7), M.L.R.Neto (54.92 and 4.11), G. Tsivgoulis (45.54 and 3.41) and A.A. Asadi-Pooya (39.2 and 2.93)(Table 6).

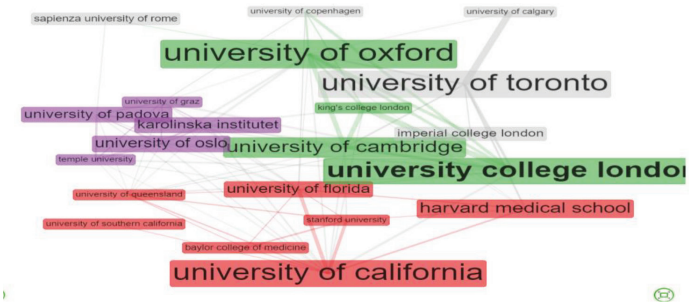

Figure 2: Collaboration Network Visualization of top Organizations.

Figure 3 presents the collaborative linkages among top 20 authors. There are different clusters represented by different colors for example, H. Zhang and J. Wang (Cluster=27), followed by X. Zhang (Cluster=15), Y. Wang (Cluster=4). The I. Zhang leads with highest number of collaboration links (90 linkages), followed by W Li (75 linkages), Z Liu (73 linkages), Y Wang (56 linkages), Q Zhang (50 linkages) and its shows total link strength and collaborations.

Top 20 Journals

In all, 376 journals partcipitated in research on the topic "Covid-19 and Neurosciences". The top 20 journals published from 55 to 311 papers each and together account for 42.46% share (2227) of global publication output. The top 8 most productive journals are: *Psychiatry Research* (311 papers). *The Lancet Psychiatry* (175 papers), *Frontiers in Neurology* (172 papers), *Journal of Neurology* (157 papers), *Brain, Behavior and Immunity* (150 papers), *PeerJ* (142 papers), *Multiple Sclerosis and Related Disorders* (139 papers) and *European Journal of Neurology* (109 papers). The top 8 most impactful journals in terms of citations per paper are: *Brain, Behavior and Immunity* (61.35). *The Lancet Psychiatry* (54.58), *Nature Human Behavior* (44.37), *Psychiatry Research* (31.58), *ACS Chemical Neuroscience* (27.17), *E-Life* (21.73), *Journal of Neurological Sciences* (15.65) and *European Journal of Neurology* (14.17) (Table 7).

High-Cited Papers

Of the 5245 total papers, 131 papers (2.50% share) received 100 to 1609 citations (assumed as high-cited papers) and these have received 3468 citations. Of the 131 high-cited papers, 79 papers have received 100-200

Table 6: Bibliometric Profile of Top 20 Authors in "Covid-19 and Neurosciences".

S.No	Name of the author	Affiliation of the author	TP	TC	CPP	RCI
1	J. Sterer.	Rudolfstifung Hospital, Vienna, Austria	24	40	1.67	0.12
2	F.A.Scorza	Universidade Federal de São Paulo, Sao Paulo, Brazil	20	55	2.75	0.21
3	E. Moro	Centre HospitalierUniversitaire de Grenoble, Grenoble, France	14	237	16.93	1.27
4	M.L.R. Neto	FMJ, Juazeiro do Norte, Brazil	13	714	54.92	4.11
5	G. Tsivgoulis	University of Athens,Medical School, Greece	13	592	45.54	3.41
6	D. Garcia-Azorin	Hospital ClínicoUniversitario de Valladolid, Valladolid, Spain	12	87	7.25	0.54
7	R. Helbok	MedizinischeUniversitat Innsbruck, Innsbruck, Austria	12	143	11.92	0.89
8	J. Seliner	LandesklinikumMistelbach-Gänserndorf, Mistelbach, Austria	12	163	13.58	1.02
9	P. Cortelli	IstitutodelleScienzeNeurologiche di Bologna, Bologna, Italy	11	87	7.91	0.59
10	H.S. Markus	University of Cambridge, Cambridge, United Kingdom	11	214	19.45	1.46
11	K.T.Thakur	Columbia University Irving Medical Center, New York, USA	11	51	4.64	0.35
12	A.A.Asadi-Pooya	Thomas Jefferson University Hospital, Philadelphia, USA	10	392	39.20	2.93
13	B.R. Bioem	Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands	10	208	20.80	1.56
14	F.Cavallieri	IRCCS AziendaUnità Sanitaria Locale di Reggio Emilia, Reggio Emilia, Italy	10	100	10.00	0.75
15	M. Filippi	Università Vita-Salute San Raffaele, Milan, Italy	10	121	12.10	0.91
16	G. Giovannoni	Barts and The London School of Medicine and Dentistry, London, U.K.	10	174	17.40	1.30
17	Z. Liu	Southern Medical University, Guangzhou, China	10	1697	169.70	12.70
18	M.A. Sahraian	Tehran University of Medical Sciences, Tehran, Iran	10	120	12.00	0.90
19	C.A. Scoraza	Universidade Federal de São Paulo, Sao Paulo, Brazil	10	25	2.50	0.19
20	P. Taba	Tartu ÜlikooliKliinikum, Tartu, Estonia	10	148	14.80	1.11
		Total of top 20 organizations	243	5368	22.09	1.65
		Global total	5245	70073	13.36	
		Share of top 20 organizations in global total	4.63	7.66		

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index

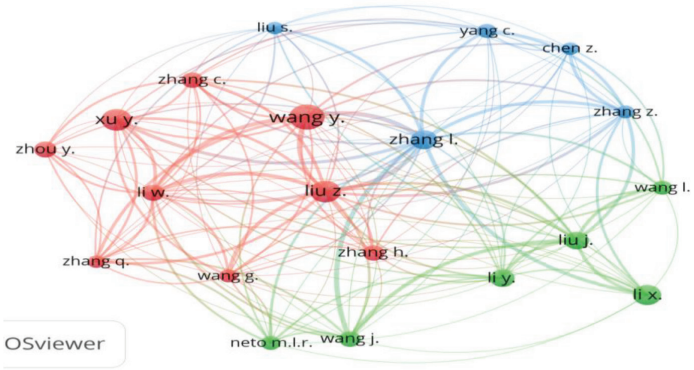

Figure 3: Collaboration Network Visualization of Authors.

Table 7: Bibliometric Profile of Top 20 Journals in "Covid-19 and Neurosciences".

S.No.	Name of the journal	TP	TC	CPP
1	Psychiatry Research	311	9821	31.58
2	The Lancet Psychiatry	175	9551	54.58
3	Frontier in Neurology	172	1003	5.83
4	Journal of Neurology	157	1804	11.49
5	Brain, Behavior and Immunity	150	9203	61.35
6	PeerJ	142	576	4.06
7	Multiple Sclerosis and Related Disorders	139	1349	9.71
8	European Journal of Neurology	109	1545	14.17
9	Journal of the Neurological Sciences	93	1455	15.65
10	Journal of Psychiatric Research	90	471	5.23
11	Eye (Basingstoke)	89	558	6.27
12	E-Life	88	1912	21.73
13	Epilepsy and Behavior	75	354	4.72
14	Psychiatry and Clinical Neurosciences	71	953	13.42
15	PLOS Computational Biology	70	249	3.56
16	ACS Chemical Neuroscience	63	1712	27.17
17	Nature Human Behavior	62	2751	44.37
18	Journal of Clinical Neurosciences	59	753	12.76
19	Journal of Clinical Sleep Medicine	57	329	5.77
20	Graefe's Archive for Clinical and Experimental	55	615	11.18
	Total of top 20 jouranls	2227	46964	21.09
	Global total			

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index

citations. 17 papers 201-285 citations, 15 papers 305-497 citations. 15 papers 504-928 citations and 5 papers 1147-1609 citations. Of the 131 high-cited papers, 69 appeared as articles, 28 as reviews, 26 as letters, 7 as notes and 1 as editorials. Twenty five (25) out of 131 high-cited papers involve zero collaboration and the 106 involve more than 2 organizations (61 national collaborative and 45 international collaborative).

USA contributed the largest number of papers (47) in 131 high-cited papers, followed by China (39 papers), U.K. (29 papers), Italy (22 papers), Australia and Germany (10 papers each), Netherlands (9 papers), Canada (8 papers), India and Singapore (7 papers each), Japan and Spain (6 papers each), France and Switzerland (5 papers each), Austria, Brazil, Denmark , Greece, Israel and Sweden (43 papers each), Belgium and Poland (3 papers each), Portugal and Turkey (2 papers each), etc.

Amongst 131 high-cited papers, 756 organizations and 1231 authors partcipitated. The 131 high cited papers are published in 46 journals, of which 26 papers are published in *Psychiatry Research*, 24 papers in *Brain, Behavior and Immunity*, 18 papers in *Lancet Psychiatry*, 8 papers in *Nature Human Behavior*, 6 papers in *E-Life*, 3 papers in *Journal of Neurology*, 2 papers each in *British Journal of Ophthalmology, Current Biology, European journal of Neurology, General Psychiatry, Journal of Clinical Neurosciences and Journal of Sleep Research* and 1 paper each in 34 other journals.

CONCLUSION

The literature on this topic "Covid-19 and Neurosciences" has been analyzed using bibliometric methods. It identified the major players (countries, organizations, authors, journals and keywords) and studied their collaboration linkages among them. It will help the decision-makers to identify the area of strength and areas which needs to be funded for future research. It will also inform and improve decision-making among physicians treating Covid-19 and scholars conducting research on this area. It will also aid in the recognition of significant extra-pulmonary manifestations of the disease among attending front-line clinicians and consulting neurologists and also help them in understanding the pandemic's broader impact on chronic disease management.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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