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Global Analysis of High Cited Papers on “Impact of COVID-19 on Mental Health” during 2020-21

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Abstract

A bibliometric analysis based on 160 highly cited papers extracted from the Scopus international database was carried out to provide insights into literature characteristics and publication performances of various participating actors on “Impact of COVID-19 on Mental Health”. Quantitative and qualitative Indicators were applied to measure the productivity and citation impact of most productive participating countries, organizations, authors, journals and significant keywords and to visualise and measure collaborative interaction among them using VOSviewer software. Results obtained from this study can provide valuable information for researchers and policy-makers to identify present and future hotspots in research on “Impact of COVID-19 on Mental Health” subfield.

Keywords: COVID-19, Mental Health, Global Publications, High-Cited Papers, Social Network Analysis, Scientometrics, Bibliometrics

1. Introduction

As the coronavirus pandemic rapidly sweeps across the world, it is inducing a considerable degree of fear, worry and concern in the population at large and among certain groups in particular, such as older adults, care providers and people with underlying health conditions. In mental health terms, the main psychological impact to date is elevated rates of stress or anxiety. But as new measures and impacts are introduced – especially quarantine and its effects on many people’s usual activities, routines and livelihoods, the mental health impact has also been measured in terms of loneliness, depression, alcohol and drug use, and self-harm or suicidal behaviour [1].

Both the COVID-19 pandemic and its management have had a negative impact on mental health worldwide. Although there is a growing body of bibliometric literature on assessment of COVID-19 literature both at national and international level, few bibliometric studies exist on the “Impact of COVID-19 on Mental Health”. Among such studies, Zambrano, Alvarez and Galindo [2] studied 223 global publications on “psychology related to COVID-19”, using the SCOPUS database. The results indicate the effects of the pandemic on mental health. Most of the studies are related to anxiety and depression and were mainly conducted in China. Maalouf, Mdawar, Meho and Akl [3] assessed the mental health research output related to the COVID-19 pandemic outbreak, using Scopus databases from the beginning of pandemic to up to 26 August 2020. Despite the shorter time since the beginning of the COVID-19 pandemic, compared to the Ebola and H1N1, the authors found a much greater number of mental health documents related to COVID-19 (n=3070) compared to the two other outbreaks (127 for Ebola and 327 for H1N1). Gul, Rehman, Ashiq and Khattak [4] examined the publishing trends on mental health literature (277 records till 15 July 2020) including top cited

documents, productive countries, institutions, journals, authorship and collaboration, the most frequent keywords and funding bodies. Grover, Gupta, Mamdapur, Mehra and Sahoo [5] examined 15223 global records on “Impact of COVID-19 on Mental Health” from Scopus database till 15 March 2021 and provided an overview of the extent of research activities in COVID-19 and mental health and identifies major research areas in the field, besides identifying key players (countries, organizations, authors, journals and keywords).

Since there was no bibliometric study available on performance of high cited research on “Impact of COVID-19 on Mental Health”, we decided to undertake the present study. In this study, we employ the bibliometric methods to analyse the high-cited papers (HCPs) on “Impact of COVID-19 on Mental Health”. The characteristic features of high-cited papers and their collaborative relationship among various actors (countries, organizations, authors, journals and keywords) of the HCPs are also presented.

2. Materials and Methods

For identifying, retrieving and downloading high cited publications data on “Impact of COVID-19 on Mental Health”, the data was sourced from the Scopus database (<https://www.scopus.com>) up to 24.04.2021. A set of keywords related to “COVID-19” and "Mental Health" were used in “Keyword tag” as well as in “Article Title tag” (joined by Boolean operator “or”) simultaneously to get global publication data (consisting of 17,608 records). Among the yielded 16895 publication records, 160 publications (0.95%) records were marked as High Cited Papers (HCPs), as these had received 100 or more citations. The search strategy further refined to get statistics by subject, collaborating country, organization, author, and journal. Citations to publications were counted from the date of their publication till February 2021. The available literature was analysed for the titles, authors, year of publication, affiliations, type of document, fields of interest, funding sources, keywords, and citation frequency, etc. The data of total 160 HCPs records were exported from the Scopus database to an Excel and CSV file for further analyses using VOSviewer, a software tool for constructing and visualizing bibliometric networks. VOSviewer software tool was used for constructing and visualizing bibliometrics networks and to analyse and visualize the networks of co-authorship relations between author, countries, and institution, and co-occurrence relations between keywords.

(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 (mental and health) and (Limit-To (Pubyear, 2021) or Limit-To (Pubyear, 2020)).

3. Analysis and Results

Of the 16895 papers found on “Impact of COVID-19 on Mental Health” using a well-defined search strategy in Scopus database, only 0.95% papers (160 papers) received citations from 100 to 2530. These were considered HCPs for the present study. The 160 HCPs published during 2020-21 received 43,775 citations. These papers involve the participation of authors from 46 countries, 1235 authors and 557 organizations and 63 papers involved international collaboration.

Of the 160 HCPs on this theme, 96 papers were in citation range 100-199, 23 papers in 208-300 citation range, 15 papers in 318-399 citation range, 11 papers in 403-499 citation range, 11 papers in 517-958 citation range and 4 papers in citation range 1267-2530 citation range. These 160 HCPs averaged 273.59 citations per paper (CPP).

Of the 160 HCPs, 55 (34.37%) have received funding support from 50+ research agencies. These 55 funded HCPs have received 17884 citations, averaging 325.16 CPP. Among the funding sources, the National Natural Science Foundation of China contributed the highest number of papers (15), followed by U.K. Research & Innovation (9 papers), National Institute of Health Research (9 papers), European Commission (6 papers), U.S. Department of Health & Human Service and National Institute of Health, USA (4 papers each), Canadian Institute of Health Research (3 papers), etc.

On classifying 160 HCPs by document type, 88 papers (55.0% share) appeared as articles, followed by reviews (27 papers and 16.88% share), letters (25 papers and 15.63% share), notes (13 papers and 8.13% share) and editorials (7 papers and 4.38% share). As expected, review papers registered the highest CPP (424.33), followed by articles (247.09), notes (277.77), letters (237.0) and editorials (148.29).

On classifying 160 HCPs on “Impact of COVID-19 on Mental Health” by Scopus subject classification, it was found that the largest number and share of the papers (129 and 80.63% share) were assigned to the ‘Medicine’ field, followed by “Neurosciences” (43 papers and 26.88% share), “Psychology” (25 papers and 15.63% share), “Environment Science” (9 papers and 5.63% share) and “Social Sciences”(3 papers and 1.88% share). Among the five subjects, Environment Science registered the highest impact (412.44) and Social Sciences the least (192.0) (Table 1).

Table 1. Distribution of papers by broad subjects

S.No	Name of the Subject	TP	TC	CPP	%TP
1	Medicine	129	36306	281.44	80.63
2	Neurosciences	43	13810	321.16	26.88
3	Psychology	25	4880	195.20	15.63
4	Environment Science	9	3712	412.44	5.63
5	Social Sciences	3	576	192.00	1.88

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

Of the 160 HCPs, 18 papers were (11.25%) from authors from single institution or country papers (with no collaboration), against 142 papers involving collaboration between 2 or more organizations. Among 142 collaborative papers, 79 papers (49.375%) involve national collaboration and 63 papers (39.375%) involve international collaboration. Among 63 international collaborative papers, 37 involved bilateral collaboration and 26 involved multinational collaboration. Unexpectedly, the Single institution Papers (SIP) registered the highest citation per paper (353.5), followed by International collaborative papers (ICP) (295.39) and Nationally collaborative papers (NCP) (237.88) (Table 2).

Table 2. Distribution of HCPs by type of collaboration

Type of Collaboration	TP	TC	CPP	% TP
SIP	18	6363	353.50	11.25
NCP	79	18793	237.89	49.375
ICP	63	18610	295.39	39.375
ICP-Bilateral	37	10745	290.41	23.125
ICP=Multilateral	26	8461	325.42	16.25
Total papers	160	43775	273.59	100

SIP=Single Institution or Country Paper; NCP=National Collaborative Papers;
 ICP=International Collaborative Papers; TP=Total papers; TC=Total citations;
 CPP=Citations per paper

3.1 Most Productive Countries

In all, authors from 46 countries participated in global high-cited papers (HCPs) on “Impact of COVID-19 on Mental Health”, but their publication productivity distribution is highly skewed.

The productivity profile of the top 18 countries is presented in Table 3. The authors from top 18 countries contributed 4 to 62 HCPs and together account for more than 100% total publication and citation share. On further analysis, it was observed that: (i) Six out of top 18 countries contributed publication share above their average productivity (15.22): China (62 papers and 38.75% global share), USA (45 papers and 28.12% global share), U.K. (34 papers and 21.25% global share), Italy (19 papers and 11.87% global share) and Australia and Canada (16 papers and 10.0% global share); (ii) Eight out of top 18 countries registered CPP and relative citation index above their group average (289.06 and 1.12): Singapore (492.18 and 1.90), Sweden (362.8 and 1.40), Brazil (340.4 and 1.31), China (339.63 and 1.31), Japan (331.2 and 1.28), Hong Kong (329.86 and 1.27), Belgium (320.0 and 1.24), U.K. (306.06 and 1.18) and (iii) Ten countries registered international collaborative share more than their group average (63.5%): France, Germany, Hong Kong and Japan (100.0% each), Canada (87.5%), Netherlands (83.3%), Singapore (81.8%), Australia (81.8%), Sweden (80.0%) and U.K. (67.6%). It means that these countries are dependent on other countries for their research output.

Even within international collaborative papers, the share of first author papers was strongest in China (76.92%), followed by India, Netherland and Spain (40.0% each), Iran (33.33%), U.K. (30.33%), etc.

On ranking countries in terms of First Authors (FA) papers and their share in national output, China again tops the list (with 56 papers and 90.32% share), followed by USA (21 papers and 46.67% share), U.K. (18 papers and 52.94% share), Italy (8 papers and 42.11% share), Australia (7 papers and 43.75% share), India (6 papers and 66.67% share), Spain (5 papers and 55.56% share), etc.

Table 3. Top 18 Most Productive Countries in HCPs on “Impact of COVID-19 on Mental Health”

S.No	Name of the Country	TP	TC	CPP	FA	% FA	ICP	%ICP	ICP-FA	% ICP-FA	RCI
1	China	62	21057	339.63	56	90.32	26	41.9	20	76.92	1.31
2	USA	45	10133	225.18	21	46.67	25	55.6	3	12.00	0.87
3	U.K.	34	10406	306.06	18	52.94	23	67.6	7	30.43	1.18
4	Italy	19	4229	222.58	8	42.11	12	63.2	1	8.33	0.86
5	Australia	16	4583	286.44	7	43.75	13	81.3	4	30.77	1.11
6	Canada	16	4116	257.25	4	25.00	14	87.5	2	14.29	0.99
7	Singapore	11	5414	492.18	4	36.36	9	81.8	2	22.22	1.90
8	India	9	2413	268.11	6	66.67	5	55.6	2	40.00	1.04
9	Spain	9	2022	224.67	5	55.56	5	55.6	2	40.00	0.87
10	France	9	2330	258.89	4	44.44	9	100.0	0	0.00	1.00
11	Germany	7	1186	169.43	2	28.57	7	100.0	2	28.57	0.65
12	Hong Kong	7	2309	329.86	1	14.29	7	100.0	1	14.29	1.27
13	Netherlands	6	1441	240.17	3	50.00	5	83.3	2	40.00	0.93
14	Brazil	5	1702	340.40	2	40.00	3	60.0	0	0.00	1.31
15	Iran	5	1112	222.40	3	60.00	3	60.0	1	33.33	0.86
16	Japan	5	1656	331.20	1	20.00	5	100.0	1	20.00	1.28
17	Sweden	5	1814	362.80	1	20.00	4	80.0	1	25.00	1.40
18	Belgium	4	1280	320.00	1	25.00	4	100.0	1	25.00	1.24
Total of 18 countries		274	79203	289.06			179	65.3	52	29.05	1.12
		160	43775	273.59							

TP=Total papers; TC=Total citations; CPP=Citations per paper; FA=First author;
ICP=International collaborative papers; RCI=Relative citation index

3.1.1 Collaborative Linkages among Top Countries

The collaborative linkages network among top 18 countries is shown in Figure 1. From the figure, it is evident that there are three clusters. The thickness of links between the countries and also the distance between them represents the degree of their research collaboration. The bigger the diameter of a collaborative network node and its font size, the bigger its weight in the research collaboration. The collaborative linkages among top 13 countries are shown in Table 4. The top three countries with largest collaborative linkages were the USA, U.K. and China. Among the country-country collaborative linkages, researchers from the China-USA and USA- U.K. topped the list, registered the highest number of collaborative linkages (11), and followed by USA-Australia, China-Canada and USA-Canada 7 linkages each respectively.

Table 4. Collaboration Linkages among the Top 13 Countries

S.No.	Country Name	Collaborative linkages with other countries	TCL (NOC)
1	China	2(11), 3(5), 4(3), 5(7), 6(6), 7(7), 8(1), 9(2), 10(1), 11(2), 12(6), 13(1)	52(12)
2	USA	1(11), 3(11), 4(2), 5(6), 6(7), 7(5), 8(3), 9(3), 10(4), 11(3), 13(3)	58(11)
3	U.K.	1(5), 2(11), 4(5), 5(7), 6(6), 7(1), 8(1), 9(4), 10(6), 11(4), 12(1), 13(3)	54(12)
4	Italy	1(3), 2(2), 3(5), 5(1), 6(3), 7(1), 9(4), 10(7), 11(5), 13(1)	32(10)
5	Australia	1(7), 2(6), 3(7), 4(1), 6(4), 7(1), 8(1), 9(2), 10(3), 11(2), 12(1), 13(2)	37(12)
6	Canada	1(6), 2(7), 3(6), 4(3), 5(4), 7(4), 8(1), 9(4), 10(4), 11(1), 13(2)	42(11)
7	Singapore	1(7), 2(5), 3(1), 4(1), 5(1), 6(4), 8(2), 9(1), 10(1), 11(1), 12(1)	25(11)
8	India	1(1), 2(3), 3(1), 5(1), 6(1), 7(2), 10(1), 12(1)	11(8)
9	Spain	1(2), 2(3), 3(4), 4(4), 5(2), 6(4), 7(1), 10(4), 11(2), 13(1)	27(10)
10	France	1(1), 2(4), 3(6), 4(7), 5(3), 6(4), 7(1), 8(1), 9(4), 11(4), 13(2)	37(11)
11	Germany	1(2), 2(3), 3(4), 4(5), 5(2), 6(1), 7(1), 9(2), 10(4), 13(3)	27(10)
12	Hong Kong	1(6), 3(1), 5(1), 7(1), 8(1)	10(5)
13	Netherlands	1(1), 2(3), 3(3), 4(1), 5(2), 6(2), 9(1), 10(2), 11(3)	18(9)

TCL=Total Collaborative Linkages; NOC=Number of Countries

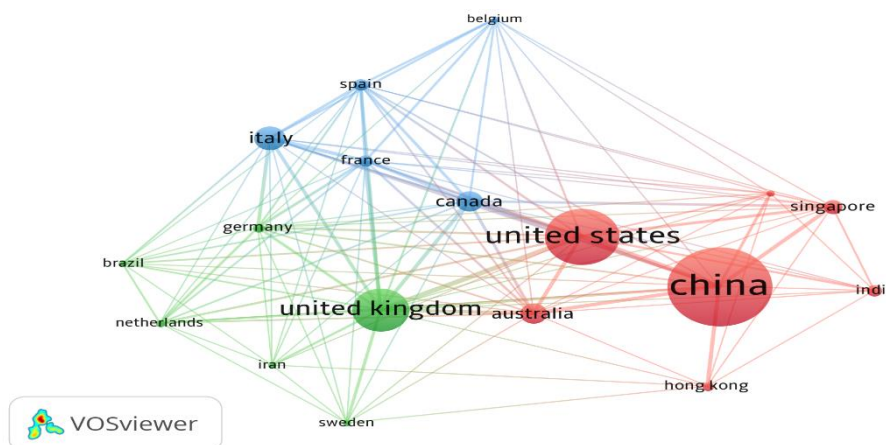


Figure 1. Network Visualization of Top Most 18 Countries

3.2 Most Significant Keywords

In this study, a total 1,645 keywords were investigated with minimum occurrence one and the size of the nodes and keywords represents the weights of the nodes. The co-occurrence linkages of the top 25 keywords which appeared in literature on “Impact of COVID-19 on Mental Health” is shown in Table 5, which shed light on the research trends in this area. The overlay visualization helped to understand

the evolution of research. The co-occurrence of the keywords using the VOSviewer software was investigated over the entire analyzed period. After being analyzed, there were 3 clusters (red and green colour with 9 items each and blue colour with 7 items respectively), which shows the relationship between one topic and another. The more often a keyword appears, the greater the size of the letters and frames as shown in Figure 3.

Table 5. Top 25 Significant Keywords appearing in Literature on “Impact of COVID-19 on Mental Health”

S.No	Keyword	Freq.	TLS	Cluster	S.No	Keyword	Freq.	TLS	Cluster
1	Coronavirus disease 2019	142	592	2 (green)	14	Mental health care	20	126	2 (green)
2	Anxiety	77	454	1 (red)	15	Social isolation	19	123	1 (red)
3	Mental health	74	386	2 (green)	16	Social support	13	89	1 (red)
4	Depression	63	372	1 (red)	17	Psychological well-being	11	89	1 (red)
5	Mental stress	43	271	3 (blue)	18	Coping behavior	11	73	3 (blue)
6	Mental disease	40	230	2 (green)	19	Psychological resilience	10	55	1 (red)
7	Quarantine	32	185	2 (green)	20	Adaptation, psychological	10	65	3 (blue)
8	Stress, psychological	32	208	3 (blue)	21	Suicide	9	54	2 (green)
9	Posttraumatic stress disorder	28	188	2 (green)	22	Emotion	9	61	3 (blue)
10	Mental health service	26	155	2 (green)	23	Job stress	9	49	3 (blue)
11	Fear	25	154	3 (blue)	24	Sleep disorder	7	56	1 (red)
12	Distress syndrome	23	164	1 (red)	25	Social distancing	6	29	2 (green)
13	Insomnia	23	154	1 (red)	Freq.=Frequency; TLS=Total Link Strength				

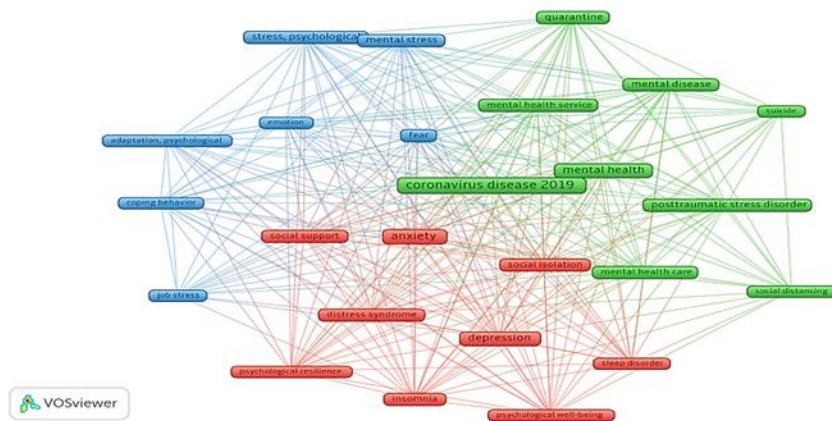


Figure 2. Network Visualization of Co-occurrence of Top 25 Keywords

3.3 Most Productive Organizations

In all a total 537 organizations unevenly participated in HCPs on “Impact of COVID-19 on Mental Health”: 511 organizations published 1-3 papers each, 20 organizations published 4-7 papers each and 6 organizations published 8-11 papers each. The productivity profile of the top 15 countries is presented in Table 6. Among the top 15 most productive organizations, 7 were from China, 4 from U.K. and 1 each from Australia, Canada, France, Italy, Singapore and the USA are shown in Table 6.

The productivity of top 15 organizations varied from 4 to 11 papers and together they accounted for 73.75% (118 papers) global publication share and 90.25% (39507 citations) global citation share. On further analysis, it was observed that : (i) Seven out of top 15 organizations published papers above their group average (7.87): Capital Medical University, China (11 papers), Huzhong University of Science & Technology, China, National University of Singapore, Wuhan University, China and King’s College London, U.K. (9 papers each), Tongji Medical College, China and Renmin Hospital of Wuhan University, China (8 papers each), (ii) Four out of top 15 organizations registered citation per paper and relative citation index above their group average (334.81 and 1.22): Zhejiang

University, China (594.25 and 2.17), King's College London, U.K. (582 and 2.13), National University of Singapore (533.33 and 1.95) and Renmin Hospital of Wuhan University, China (401.75 and 1.47) and (iii) Eight out of 15 organizations registered international collaborative share more than their group average (55.08%): University College, London(85.71%), University of Macau, University of Oxford and University of Melbourne, Australia (80.0% each), National University of Singapore and King's College London, U.K. (66.67% each), Renmin Hospital of Wuhan University, China (62.5%) and University of Toronto, Canada (57.14%).

On ranking top 15 organizations in terms of First Authors (FA) papers and their share in national output, Capital Medical University, China, University College, London and University of Macau tops the list (3 papers each and national share from 27.27% to 60.0%), National University of Singapore, King's College London, U.K., Renmin Hospital of Wuhan University, China, University of Toronto, Canada and Peking University (2 papers each and national share from 22.22 to 40.0%), etc.

Table 6. Top 15 Most Productive Research Organizations

S.No	Name of the Organization	TP	TC	CPP	FA	%FA	ICP	%ICP	RCI
1	Capital Medical University, China	11	2475	225	3	27.27	5	45.45	0.82
2	Huzhong University of Science & Technology, China	9	2927	325.22	0	0	4	44.44	1.19
3	National University of Singapore	9	4800	533.33	2	22.22	6	66.67	1.95
4	Wuhan University, China	9	2245	249.44	1	11.11	2	22.22	0.91
5	King's College London, U.K.	9	5238	582	2	22.22	6	66.67	2.13
6	Tongji Medical College, China	8	2467	308.38	0	0	4	50	1.13
7	Renmin Hospital of Wuhan University, China	8	3214	401.75	2	25	5	62.5	1.47
8	University College, London	7	2037	291	3	42.86	6	85.71	1.06
9	University of Toronto, Canada	7	1586	226.57	2	28.57	4	57.14	0.83
10	University of Macau	5	1534	306.8	3	60	4	80	1.12
11	University of Oxford	5	1566	313.2	1	20	4	80	1.14
12	University of Melbourne, Australia	5	1494	298.8	0	0	4	80	1.09
13	Peking University	5	1251	250.2	2	40	2	40	0.91
14	Cambridge University	5	1322	264.4	1	20	2	40	0.97
15	Zhejiang University, China	4	2377	594.25	1	25	1	25	2.17
13	Universita degli Studi di Roma La Sapienza, Italy	4	742	185.5	1	25	2	50	0.68
14	John Hopkins Bloomberg School of Public Health, USA	4	944	236	1	25	2	50	0.86
15	INSERM, France	4	1288	322	1	25	2	50	1.18
Total of 15 organizations		118	39507	334.81	26		65	55.08	
Global total		160	43775	273.59					
Share of top 15 organizations in global total		73.75	90.25						
TP=Total papers; TC=Total citations; CPP=Citations per paper; FA=First author; ICP=International collaborative papers; RCI=Relative citation index									

3.3.1 Collaboration among top organizations

A collaborative linkages network chart generated through biblioshiny tool of top 15 organizations is presented in Figure 3. The node indicates the number of publications, the more the number of publications the larger the node size. All top 15 most productive organizations that collaborated in HCPs have one-to-one collaborative linkages, as observed from Table 7. The top four organizations with largest collaborative linkages were Capital Medical University, China, Huzhong University of Science & Technology, China, Wuhan University, China and University College of London, U.K. respectively. Among the individual organization to organization collaborative linkages, Huzhong

University of Science & Technology, China - Tongji Medical College, China have registered the highest number of collaborative linkages (6 each) followed by Capital Medical University, China - University of Macau, China and Wuhan University, China - Renmin Hospital of Wuhan University, China (5 each) and Huzhong University of Science & Technology, China - Wuhan University, China; National University of Singapore - University of Toronto, Canada and King’s College London, U.K. - University College, London (4 each) respectively.

Table 7. Collaborative Linkages among Top Organizations

S.No	Name of the Organization	Collaborative linkages with other Organization	TCL(NOO)
1	Capital Medical University, China	2(2), 4(3), 6(2), 7(2), 10(5) , 12(2)	16(6)
2	Huzhong University of Science & Technology, China	1(2), 4(4) , 6(6) , 7(3)	15(4)
3	National University of Singapore	9(4) , 14(3)	7(2)
4	Wuhan University, China	1(3), 2(4) , 6(2), 7(5)	14(4)
5	King’s College London, U.K.	8(4) , 11(2), 14(2), 19(1)	9(4)
6	Tongji Medical College, China	1(2), 2(6) , 4(2), 7(2)	12(4)
7	Renmin Hospital of Wuhan University, China	1(2), 4(5) , 6(2), 15(3)	12(4)
8	University College, London	5(4) , 11(3), 12(1), 16(2), 18(3)	13(5)
9	University of Toronto, Canada	3(4) , 17(3)	7(2)
10	University of Macau	1(5) , 12(2)	7(2)
11	University of Oxford	5(2), 8(3)	5(2)
12	University of Melbourne, Australia	8(1), 10(2), 14(1)	4(3)
13	Peking University	15(1)	1(1)
14	Cambridge University	5(2), 8(2), 12(1)	5(3)
15	Zhejiang University	7(3), 13(1)	4(2)
TCL=Total Collaborative Linkages; NOO=Number of Organizations			

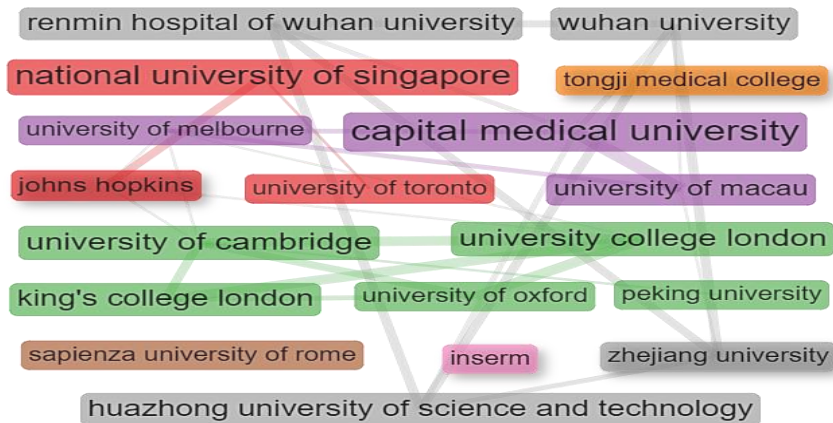


Figure 3. Collaboration Network of Top 15 Organizations

3.4 Most Productive Authors

In all a total of 1,235 authors were found to have contributed to high cited research on “Impact of COVID-19 on Mental Health” during 2020-21. Of these, 1,224 authors published 1-3 papers each, 8 authors 4 papers each and 3 authors 5 papers each. Of the top 17 authors, 10 were from China, 4 from Singapore and 1 each from Canada, Hong Kong and U.K. The high cited research productivity of top 17 most productive authors varied from 3 to 5 publications per author is represented in Table 8.

On further analysis it was observed that: (i) Eleven out of top 17 authors published the number of papers above their group average (3.82): T. Cheung and S. Wessley (5 papers each), Z. Liu, Q. Zhang,

L. Kang, W. Li, Y. Yang, R.S. McIntyre, C.S. Ho and R.C. Ho (4 papers each); (ii) Seven out of top 17 authors registered citation per paper and relative citation index above their group average (437.06 and 1.60): S. Wessley (856.6 and 3.13), Q. Zhang (355.0 and 1.30), C.S. Ho (686.5 and 2.51), R.C. Ho (686.5 and 2.51), S. Ma (603.67 and 2.21), Y. Wang (603.67 and 2.21), Z. Cai (603.67 and 2.21) and R. Li (603.67 and 2.21); and (iii) Eight out of 17 authors registered international collaboration share more than their group average (72.31%): T. Cheung , Z. Liu and R.S. McIntyre (100.0% each), Y.T. Xiang (80.0%), Q. Zhang, W. Li, Y. Yang and R.C. Ho (75.0% each).

Table 8. Scientometric Profile of Most Productive Authors

S.No	Author	Affiliation	TP	TC	CPP	FA	%FA	ICP	%ICP	RCI
1	T. Cheung	Hong Kong Polytechnic University	5	1530	306	0	0	5	100.00	1.12
2	Y.T. Xiang	University of Macau	5	1530	306	2	0.34	4	80.00	1.12
3	S. Wessley	King's College, London	5	4283	856.6	0	0	2	40.00	3.13
4	Z. Liu	Renmin Hospital of Wuhan University	4	1345	336.25	0	0	4	100.00	1.23
5	Q. Zhang	Capital Medical University, China	4	1420	355	0	0	3	75.00	1.30
6	L. Kang	Renmin Hospital of Wuhan University	4	1345	336.25	2	0.34	2	50.00	1.23
7	W. Li	University of Macau	4	640	160	1	0.17	3	75.00	0.58
8	Y. Yang	University of Macau	4	640	160	1	0.17	3	75.00	0.58
9	R.S. McIntyre	University of Toronto	4	1088	272	0	0	4	100.00	0.99
10	C.S. Ho	National University of Singapore	4	2746	686.5	2	0.34	2	50.00	2.51
11	R.C. Ho	National University of Singapore	4	2746	686.5	0	0	3	75.00	2.51
12	S. Ma	Renmin Hospital of Wuhan University	3	1811	603.67	0	0	2	66.67	2.21
13	Y. Wang	Renmin Hospital of Wuhan University	3	1811	603.67	0	0	2	66.67	2.21
14	Z. Cai	Renmin Hospital of Wuhan University	3	1811	603.67	0	0	2	66.67	2.21
15	R. Li	Renmin Hospital of Wuhan University	3	1811	603.67	0	0	2	66.67	2.21
16	V.K. Sharma	National University of Singapore	3	1041	347	1	0.17	2	66.67	1.27
17	R. Ho	National University of Singapore	3	811	270.33	0	0	2	66.67	0.99
Total of 17 authors			65	28409	437.06	9	13.85	47	72.31	1.60
Global total			160	43775	273.59					
Share of 17 authors in global total			40.63	64.90						
TP=Total papers; TC=Total citations; CPP=Citations per paper; FA=First author; ICP=International collaborative papers; RCI=Relative citation index										

3.4.1 Collaboration Linkages among Top Authors

A collaborative linkages network chart generated through biblioshiny tool of top 17 authors is presented in Figure 4. The node indicates the number of publications, the more the number of publications the larger the node size. All top 17 most productive authors that collaborated in HCPs have one-to-one collaborative linkages, as observed from Table 9. Except for one, all the other top 16 authors have one to one collaborative linkages, as observed from Table 9. The top three authors with largest collaborative linkages depicted by Z. Liu, L. Kang and Y.T. Xiang. Among the author to author collaborative linkages, T. Cheung - Y.T. Xiang had the largest number of collaborative linkages (5), followed by T. Cheung - Y. Yang; Y.T. Xiang - Q. Zhang; Y.T. Xiang - Y. Yang and W. Li - Y. Yang (4 linkages each) respectively.

Table 9. Collaborative Linkages among Most Productive Authors

S.No	Author	Affiliation	Collaborative linkages with other Authors	TCL(NOO)
1	T. Cheung	Hong Kong Polytechnic	2(5), 5(1), 7(3), 8(4)	13(4)

		University		
2	Y.T. Xiang	University of Macau	1(5), 5(4), 7(3), 8(4)	16(4)
3	S. Wessley	King's College, London	Nil	Nil
4	Z. Liu	Renmin Hospital of Wuhan University	2(3), 8(3), 6(3), 9(3), 10(3), 11(3), 12(3)	21(7)
5	Q. Zhang	Capital Medical University, China	1(4), 2(4), 7(2), 8(3)	13(4)
6	L. Kang	Renmin Hospital of Wuhan University	4(6), 9(3), 10(3), 11(3), 12(3)	18(5)
7	W. Li	University of Macau	1(4), 2(4), 8(4)	12(3)
8	Y. Yang	University of Macau	1(4), 2(4), 7(4)	12(3)
9	R.S. McIntyre	University of Toronto	1(2), 2(2), 16(1), 17(1)	6(4)
10	S. Ma	Renmin Hospital of Wuhan University	6(3), 11(3), 12(3), 13(3)	12(4)
11	Y. Wang	Renmin Hospital of Wuhan University	6(3), 10(3), 12(3), 13(3)	12(4)
12	Z. Cai	Renmin Hospital of Wuhan University	6(3), 10(3), 11(3), 13(3)	12(4)
13	R. Li	Renmin Hospital of Wuhan University	6(3), 8(3), 10(3), 11(3)	12(4)
14	C.S. Ho	National University of Singapore	13(4), 16(2), 18(3)	9(3)
15	R.C. Ho	National University of Singapore	13(4), 17(2)	6(2)
16	V.K. Sharma	National University of Singapore	14(4), 17(2)	6(2)
17	R. Ho	National University of Singapore	14(2), 15(2)	4(2)

TCL=Total Collaborative Linkages; NOO=Number of Organizations

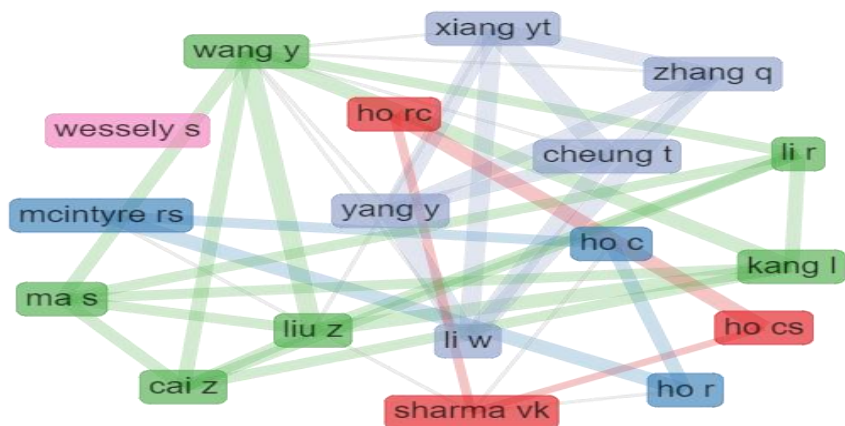


Figure 4. Collaboration Network of top 17 Authors

3.5 Channels of Research Communications

The HCPs on “Impact of COVID-19 on Mental Health” were published in 84 journals. Of the 84 journals that had reported 160 high-cited articles, 78 journals published 1-4 papers each, 4 journals published 6-9 papers each, and 2 journals published 12-13 papers each during 2020-21. The top 19 most productive journals accounted for a 56.25% share of the high-cited papers on “Impact of COVID-19 on Mental Health” during the period.

Table 10 shows the number of HCPs and their citation indicators in the top 19 productive journals with 2 or more papers. The Lancet Psychiatry is the most productive journal which published 12 HCPs. The number of HCPs published by Brain, Behavior and Immunity and Asian Journal of Psychiatry ranks second (n=12) and third (n=9) in the top 19 productive journals respectively. For the top 19 journals, HCPs published by The Lancet Psychiatry and the Lancet have the highest total

citations (TC). These two journals have been cited 5052 and 4081 times in total. However, HCPs published by The Lancet and International Journal of Environment Research & Public Health have the highest average citations per paper (CPP), which reached 583.0 and 502.33 times. Figure 4 shows TC values and impact factor (IF) of each of the top 19 productive journals. For HCPs, the variation trend of TC and CPP values is not consistent with that of journal IF. The most obvious one is The BMJ and the BMJ Public Health. The IF of these two journals ranks at second and third position in the top 19 journals, however, its TC values ranks at 8th and 10th position and CPP values ranks 11th and 10th position. A co-citation network map of top 19 most productive journals depicts 8 clusters as shown in Figure 5. In the map, two or more journals that cover closely related topics are placed close to one another, and those covering fundamentally different topics are located far from each other. The circle size and font size of a journal node is proportional to the frequency of its co-citations. Cluster 1 in red colour has 4 journals i.e. (JAMA Psychiatry, JAMA-Journal of the American Medical Association, The Lancet Psychiatry and The Lancet Public Health), Cluster 2 in green colour has 4 journals (Journal of Sleep Research, The BMJ, The Lancet and The Lancet Child & Adolescent Health) and Clusters 3 and 4 are in blue and yellow colour with three journals, cluster 5 are in purple colour with 2 journals and cluster 6, 7 and 8 with 1 journal each respectively.

Table 10. List of Top 19 Most Productive Journals in High Cited Papers

S.No	Name of the Journal	IF-2019	TP	TC	CPP
1	The Lancet Psychiatry	16.209	13	5052	388.62
2	Brain, Behavior and Immunity	6.633	12	3241	270.08
3	Asian Journal of Psychiatry	2.509	9	1962	218.00
4	Psychiatry Research	2.118	8	2595	324.38
5	The Lancet	60.392	7	4081	583.00
6	International Journal of Environment Research & Public Health	2.849	6	3014	502.33
7	Medical Science Monitor	1.918	4	716	179.00
8	The BMJ	30.223	4	835	208.75
9	JAMA-Journal of the American Medical Association	45.540	3	573	191.00
10	International Journal of Biological Sciences	4.858	3	994	331.33
11	International Journal of Mental Health & Addition	1.648	3	743	247.67
12	The Lancet Public Health	16.292	3	633	211.00
13	The Lancet Child & Adolescent Health	8.543	3	436	145.33
14	International Journal of Social Psychiatry	1.725	2	601	300.50
15	JMIR Public Health Surveillance	3.500	2	343	171.50
16	JAMA Psychiatry	17.500	2	322	161.00
17	Journal of Sleep Research	3.623	2	305	152.50
18	JAMA Paediatrics	13.946	2	295	147.50
19	Journal of Anxiety Disorders	3.079	2	241	120.50
Total 84 journals					

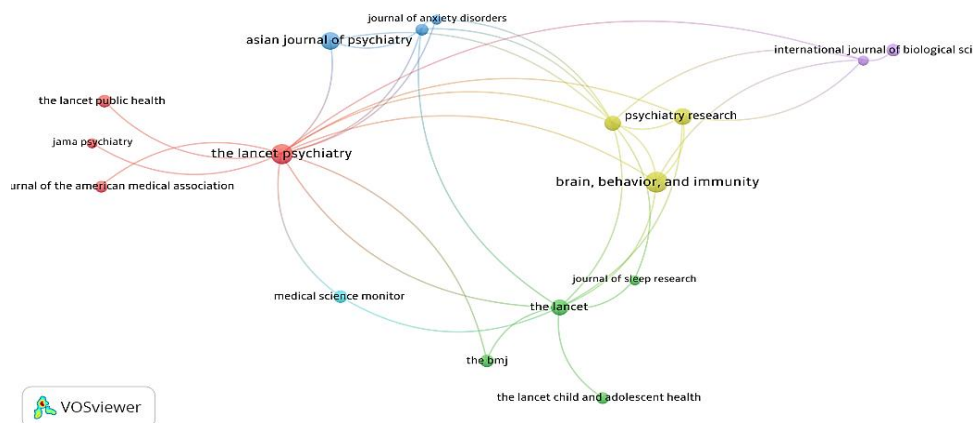


Figure 5. Co-citations Network Visualization Map of Top 19 Productive Journals

4. Summary & Conclusion

The study analysed 160 HCPs published during 2020-21, which have received 43,775 citations and involve the participation of 46 countries, 1235 authors and 557 organizations and among them 63 papers involve [international collaboration. These 160 papers received citations from 100 to 2530.

In the above study, bibliometric methods have been used by authors to analyse HCPs on “Impact of COVID-19 on Mental Health” using the Scopus database. The influence of most productive countries, organizations and authors and journals was evaluated. As for countries involved, China, USA and U.K. are the most productive organizations (with 62. 45 and 34 papers) and Singapore (492.18 and 1.90), Sweden (362.8 and 1.40), Brazil (340.4 and 1.31) have the highest citation per paper and relative citation index. Capital Medical University, China (11 papers), Huzhong University of Science & Technology, China and National University of Singapore (9 papers) are the most productive organizations and Zhejiang University, China (594.25 and 2.17), King’s College London, U.K. (582 and 2.13), National University of Singapore (533.33 and 1.95) has the highest citation per paper and relative citation index. T. Cheung (Hong Kong Polytechnic University), Y.T. Xiang (University of Macau) and S. Wessley (King’s College, London) are the most productive authors with 5 papers each). S. Wessley (King’s College, London (856.6 and 3.13), Q. Zhang (Capital Medical University, China) (355.0 and 1.30), C.S. Ho and R.C. Ho (National University of Singapore) (686.5 and 2.51 each) have the highest citation per paper and relative citation index.

The interaction among productive countries, organizations, authors and keywords was analysed. In international collaborations, USA, U.K and China are placed at the central position (with total collaborative linkages (58, 54 and 52) indicating their research potential in “Impact of COVID-19 on Mental Health” field. For organizations, Capital Medical University, China, Huzhong University of Science & Technology, China, Wuhan University, China and University College of London, U.K. reported the highest collaborative linkages (from 13 to 16). Among authors, Z. Liu, L. Kang and Y.T. Xiang reported the highest collaborative linkages (from 16 to 21). The relationship networks among productive countries/territories, organizations, authors and keywords were also visualized using VOSviewer. The Lancet Psychiatry, Brain, Behavior and Immunity, Asian Journal of Psychiatry and Psychiatry Research reported the highest number of high-cited papers (from 8 to 13).

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