J Young Pharm, 2021; 13(3) Suppl: s78-s83
A multifaceted peer reviewed journal in the field of Pharmacy
www.jyoungpharm.org | www.phcog.net

Original Article

Covid-19 and Heart Diseases: A Scientometric Assessment of Global Publications during 2020-21

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ABSTRACT

Background: Many patients with Covid-19 have underlying cardiovascular disease or develop acute cardiac injury during the course of the illness. Adequate understanding of the interplay between Covid-19 and Cardiovascular disease is required for optimum management of these patients. The study analyzed and evaluated the global publication output on "Covid-19 and Heart Diseases" to find out the current trends and present status of research, by identifing important countries, organizations, authors and journals and important topics and keywords from the global publications, using bibliometric methods. **Methods:** Relevant published literature from December 2019 to August 2021 were identified and analyzed on the topic "Covid-19 and Heart Diseases" using a well-defined search strategy in Scopus database. A list of keywords were identified for Covid-19 ("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 Heart Diseases (cardi* or arrhythmia or myocardial* or heart*) and these keywords are used for search in "Keywords" and Title" tags of Scopus database, yielding 5298 records. **Results:** A total of 5298 relevant publications indexed in Scopus database were obtained on "Covid-19 and Heart Disease", which received 62459 citations, averaging 11.79 citations per paper. The total publications witnessed the participation of 123 countries, with USA, Italy, U.K. and China leading in global publication productivity (with 1757, 707, 551 and 413 papers) and China (35.31 and 2.99), France (23.01 and 1.95), Germany (23.0 and 1.95) and Italy (20.43 and 1.73) leading in citation impact per publication and relative citation index. The 1761 organizations and 2499 authors participated in these 5298 publications. Harvard Medical School, USA, Brigham and Women's Hospital, USA and Massachsetts General Hospital leads in publications productivity (with 178, 92 and 92 publications each) and New York Presbyterian Hospital, USA (121.53 and 10.31), Tongji Medical College, China (65.65 and 5.57) and Huazhong University of Science and Technology, China (65.41 and 5.55) leads in citations impact per paper and relative citation index. M. Metra, A. Harky and M.K. Chung leads in publications productivity (with 23, 22 and 153 papers each) and G.Y.H. Lip (U.K.)(114.67 and 9.73), A.J. Kirtane (USA)(109.67 and 9.3) and M. Metra (Italy)(87.04 and 7.38) leads in citations impact per publication and relative citation index. *European Heart Journal*, *Circulation* and *Stroke* leads in publication productivity (with 85, 81 and 73 publications) and *JAMA Cardiology* (154.23), *Journal of the American College of Cardiology* (54.99) and *Circulation* (43.54) leads in citation impact per paper. Major keywords appearing along with "Covid-19 and "Heart Diseases" in co-occurnces were "Cardiovascular Disease" (1176), "Heart Failure" (802), "Hypertension" (664), "Cerebrovascular Accidents" (659), "Stroke" (608), "Mycarditis" (511), "Heart Arrhytthrmia"(464), etc. **Conclusion:** The study presents the current trends and status of research in the field and indicate the important keywords where research is focused in global literature on cardiovascular manifestations in Covid-19 patients. Such a analysis tmay be useful to the research community and decision-makers to prioritize research needs and identify leading Covid-19 researchers, countries, institutes and authors.

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DOI: 10.5530/jyp.2021.13s.75

INTRODUCTION

Coronavirus disease 2019 was first reported in Wuhan, China, in late December 2019. Since then, Covid-19 has spread rapidly worldwide and has become a global pandemic affecting >200 countries and territories, with an unprecedented effect not only on public health, but also social and economic activities.[1] The interaction between the viral spike (S) protein and angiotensin-converting enzyme 2 (ACE2) is likely to have a central role in disease pathogenesis, especially in cardiovascular manifestations of this disease, and this interaction is a potential target for the prevention and treatment of Covid-19. host cells, which is likely to be involved in the cardiovascular manifestations of Covid-19.[1] However, in addition to respiratory symptoms, uncontrolled SARS-CoV-2 infection can trigger a cytokine storm, where by pro-inflammatory cytokines and chemokines such as tumour necrosis factor-α, IL-1β and IL-6 are over-produced by the immune system, resulting in multiorgan damage.[2]

The presence of underlying or pre-existing cardiovascular comorbidities in patients with Covid-19 is associated and linked with worse outcomes and increased risk of death in patients. Cardiovascular disease (CVD) is a common comorbidity observed in patients infected with SARS. Among the comorbidity, the most common underlying diseases were diabetes, hypertension, coronary heart disease, obesity, cancer and other CVDs. In addition, the prevalence of these pre-existing conditions was higher in critically ill patients (such as those admitted to the intensive care unit (ICU)) and in (those who died).[1] Covid-19 can cause cardiovascular disorders, including myocardial injury, arrhythmias, acute coronary syndrome and venous thromboembolism.[3-5]

Children with Covid-19 have also been reported to develop hyperinflammatory shock with features akin to including cardiac dysfunction and coronary vessel abnormalities. The studies also indicate the presence of a bidirectional interaction between Covid-19

and the cardiovascular system, but the mechanisms underlying this interaction remain elusive. The high burden of systemic inflammation associated with Covid-19 has been proposed to accelerate the development of subclinical disorders or cause de novo cardiovascular damage.[2,6-9]

Several medications used for the treatment of Covid-19 have uncertain safety and efficacy profiles. Potential drug–disease interactions affecting patients with Covid-19 and comorbid cardiovascular diseases are also becoming a serious concern.[10-12]

Literature Review

Although a number of bibliometric studies are conducted both on coronovirus in general and Covid-19 in particular. Also a few bibliometric studies are undertaken on the Impact of "Covid-19 and Heart Diseases". Among such studies, Sinnenberg *et al.*[13] examined gender differences in authorship of manuscripts in select high-impact cardiology journals during the early coronavirus disease 2019 pandemic, using data in 4 high-impact cardiology journals between March 1, 2019 to June 1, 2019 and March 1, 2020 to June 1, 2020. Sabatino *et al.*[14] presented a meta-analysis of observational studies (among 77317 hospitalized patients from 21 studies) evaluating cardiovascular (CV) complications in hospitalized Covid-19 patients and the impact of cardiovascular risk factors or comorbidities on mortality, using data from PubMed, Scopus, and ISI from 1 December 2019 through 11 June 2020. Cardiovascular complications are frequent among Covid-19 patients, and might contribute to adverse clinical events and mortality.

Objectives

The main objectives of this paper is to analyse literature on cardiovascular outcomes among patients hospitalized and cardiovascular risk factors associated with patients suffering from Covid-19. The study presents an evaluation of research based on global publications indexed in Scopus database, using quantitative and qualitative indicators. The major focus of present analysis is to study on characterstics of overall literature and identification of: (i) key countries, organizations and authors and their collaborative linkages, (ii) key sources publishing on this topic and (ii) key subject area and important keywords reflecting the trends of research in this area; and (iv) characterstics of high cited publications.

Methodology

Using a well-conceived search strategy, the authors performed a bibliometric search on the theme "Covid-19 and Heart Diseases" and identified, retrieved and downloaded all relevant publications records from the Scopus database (https://www.scopus.com), using two set of keywords related to "Covid-19" and "Heart Diseases". These wo set of keywords are used in field tags, "Keyword" or"Title" (Article Title) and limiting the search up to 28.9.2021. The search yielded 5298 records, which were further analyzed using additional analytical provisions in the Scopus database.

((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 (TITLE (cardi* or arrhythmia or myocardial* or heart* or carebrovas* or stroke or thromboe*))) and (LIMIT-TO (SRCTYPE , "j"))

Analysis and Results

Overall Output

The global output on "Covid-19 and Heart Diseases" consisted of 5298 publications (2019=2, 2020=2642 and 2021=2654), as indexed in Scopus database till 28.9.2021. These 5298 global publications received 62459 citations, averaging 11.79 citations per publication. Of the 5298 global publications on this theme, 806 (15.21%) received external funding support and they together registered 15816 citations, averaging 19.62 citations per publication. The leading global agencies providing funding support (along with their output) to research in this area are National Institute of Health, USA (101 papers), National Natural Science Foundations of China (104 papers), National Heart, Lung and Blood Institute (74 papers), Medtronic (66 papers), Abbott Laboratories (57 papers), AstraZeneca (56 papers), Bayer (52 papers), Pfizer (51 papers), National Institute of Heart Research (50 papers), etc. Of the 5298 total global publications, articles constituted the largest share (53.13%), followed by reviews (16.70%), letters (14.93%), editirials (7.10%), notes (5.175), erratum(1.30%), short surveys (1.17%) and others contribute less than 1.0%: conference papers (0.28%), book chapters (0.17%) and data paper (0.02%).

Top 10 Countries

123 countries unevenly participated in global research on "Covid-19 and Heart Diseases": 73 countries contributed 1-10 papers each, 23 countries 11-50 papers each, 11 countries 51-100 papers each, 13 countries 101-500 papers each and 3 countries 551 to 1757 papers each. The top 10 countries individually contributed 179 to 1757 papers each and together contributed 93.37% and more than 100% share in global publications and citations. Among top 10 countries, the largest contribution is made by USA (with 33.16% global share), followed by Italy (13.34% share), U.K. (10.40% share), China (7.80% share), Germany, Spain, Canada, France, India and Brazil (from 3.38% to 5.87% share). Three out of top 10 countries contributed more than average publications (529.8) of all 10 countries: USA (1757 papers), Italy (707 papers) and U.K. (551 papers). Four out of top 10 countries registered citations per paper and relative citation index higher than their group average (17.63 and 1.50): China (35.31 and 2.99), France (23.01 and 1.95), Germany (23.0 and 1.95) and Italy (20.43 and 1.73) The share of international collaborative papers of top 10 countries varied from 30.18% to 70.48%, with an average of 39.86% (Table 1).

Figure 1 shows the collaborative network map of productive countries, generated using the VOSviewer. The map presents 46 countries in 11 clusters with 210 links and total link strength of 235. Each node represents a country and its size represents its productivity. The lines connecting the nodes shows their collaboration. Higher the thickness of links, higher the collaboration. Red cluster contains 11 countries including China Denmark, New Zealand etc. Light green cluster has 5 countries including United States, Peru, Nepal, etc.

Subject-Wise Distribution of Publications

On classifying 5298 publications on "Covid-19 and Heart Diseases" according to Scopus database classification, it was observed that Medicine account for the largest share (92.15%) in total output, followed Biochemistry, Genetics and Molecular Biology (6.72%), Nursing (4.93%), Neurosciences (4.21%), Pharmacology, Toxicology and Pharmaceutics complications (2.74%), Immunology and Microbiology (1.74%) etc. In terms of impact, Medicine registered the highest citation impact per paper (12.54) and Social Sciences the least (1.51)(Table 2)

Table 1: Profile of Top 10 Countries in Global Output in "Covid-19 and Heart Diseases."

S. No.	Country	TP	TC	CPP	*h*-Index	ICP	%ICP	RCI	%TP
1	USA	1757	26283	14.96	71	603	34.32	1.27	33.16
2	Italy	707	14447	20.43	50	259	36.63	1.73	13.34
3	U.K.	551	7656	13.89	37	284	51.54	1.18	10.40
4	China	413	14582	35.31	44	141	34.14	2.99	7.80
5	Germany	311	7152	23.00	31	142	45.66	1.95	5.87
6	Spain	302	4232	14.01	28	118	39.07	1.19	5.70
7	Canada	271	4270	15.76	26	191	70.48	1.34	5.12
8	France	234	5384	23.01	30	97	41.45	1.95	4.42
9	India	222	1245	5.61	16	67	30.18	0.48	4.19
10	Brazil	179	1987	11.10	15	70	39.11	0.94	3.38
	Total	4947	87238	17.63	348	1972	39.86	1.50	93.37
	Global Total	5298	62459						

TP=Total papers; TC=Total citations; CPP=Citations per paper; ICP=International collaborative papers

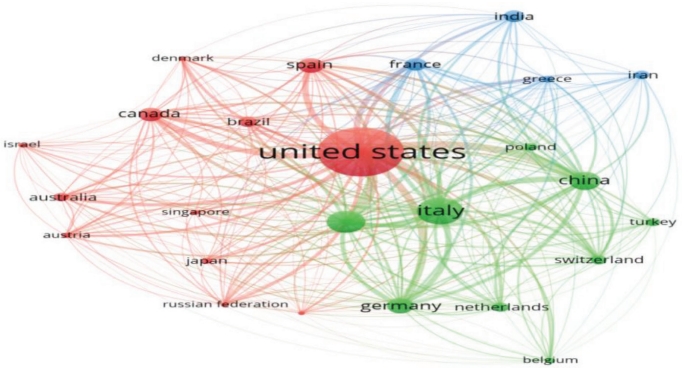

Figure 1: Coauthorship collaborative network of countries.

Table 2: Subject-Wise Distribution of Papers.

S.No	Name of the Subject	TP	TC	CPP
1	Medicine	4882	61242	12.54
2	Biochemistry, Genetics and Molecular Biology	356	4431	12.45
3	Nursing	261	3157	12.10
4	Neurosciences	223	2268	10.17
5	Pharmacology, Toxicology and Pharmaceutics	145	752	5.19
6	Immunology and Immunology	92	775	8.42
7	Social Sciences	49	74	1.51
8	Computer Science	48	227	4.73
9	Engineering	48	338	7.04
10	Environmental Science	31	79	2.55
	Global Total	5298		

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

Significant Keywords

The 48 significant keywords (with frequency of appearance varying from 171 to 4799) have been identified from the literature, which throw light on the trends of research on his theme. The largest frequency of occurrence (237) of keywords related to the main topic "Covid-19 and Heart Diseases" were "Cardiovascular Disease"(1176), "Heart Failure" (802), "Hypertension" (664), "Cerebrovascular Accidents" (659), "Stroke" (608), "Mycarditis" (511), "Heart Arrhytthrmia"(464), etc. (Table 3)

A visualization map of co-occurences of keywords are presented in Figure 2, where keywords have been presented in different clusters represented by various colours. Related keywords are found in the same cluster.

Profile of Top 25 Organizations

In all 1761 organizations participated unevenly in global research on "Covid-19 and Heart Diseases": 776 organizations contributed 1-5 paper each, 443 organizations 6-10 papers each, 376 organizations 11-20 papers each, 84 organizations 21-30 papers each, 55 organizations 31-50 papers each, 25 organizations 51-100 papers each and 2 organizations 131-178 papers each.

The top 25 organization individually contributed 53 to 178 papers and together contributed 34.03% (1803 papers) share and 90.11% (56281 citations) share respectively in global publications and citations. On further analysis, it was observed that: (i) Eleven organizations contributed papers higher than their group average (72.12) and (ii) Thirteen organizations registered citation per paper and relative citation index above their group average (31.22 and 2.65). Table 3 lists the top 10 most productive and 10 most impactful organizations (Table 4).

Profile of Top 25 Authors

2499 authors participated unevenly in global research on "Covid-19 and Heart Diseases": 2314 authors contributed 1-5 papers each, 151 authors 6-10 papers each, 32 authors 11-20 papers each, 2 authors 21-23 papers each. The top 25 authors individually contributed 11 to 23 papers each and together contributed 6.17% (327) and 16.88% (10541) shares in global publications and citations. On further analysis, it was observed that: (i) Five authors contributed papers higher than their group average (13.08) and (ii) Two authors registered citation per paper and relative citation index above their group average (32.24 and 2,73). Table 5 lists the top 10 most productive and 10 most impactful authors (Table 5). A network visualization map of top 25 authors in shown in Figure 3.

Profile of Top 25 Journals

Of the 5298 publications, 5270 are published in journals, 13 in conference proceedings, 4 each as book series, books and in trade journal. The

Table 3: List of Significant Keywords appearing in Literature on "Covid-19 and Heart Diseases."

S.No.	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency
1	Covid-19	4799	18	Heart Disease	358	35	Mycardial Infarction	230
2	Pandemic	2614	19	Brain Ischemia	352	36	Thromboembolism	230
3	Virus Pneumonia	1523	20	Lung Embolism	349	37	Computed Tomography Angiography	212
4	Cardiovascular Disease	1176	21	Dyspnea	336	38	Heparin	208
5	Heart Failure	802	22	Heart Infarction	335	39	Coronary Angiography	198
6	Hypertension	664	23	Venous Thrombrembolism	332	40	Heart Arrest	194
7	Cerebrovascular Accidents	659	24	Electrocardiography	305	41	Heart Surgies	193
8	Virology	629	25	Acute Coronary Syndrome	304	42	Ischemic Stroke	193
9	Stroke	608	26	Cardiovascular Risk	298	43	NMR Imaging	188
10	Cormorobidity	595	27	Anticoagulanr Agents	278	44	Cytikine Storm	184
11	Myocarditis	511	28	Coronary Artery Disease	278	45	Cardiovascular Magnetic Resonance	174
12	Heart Arrhythrmia	464	29	Atrial Fibrillation	264	46	Renin Angiotensin Aldosterone	174
13	D.Dimer	450	30	Biological Markers	255	47	Cardiogenic Shock	172
14	Hydroocycholoroquine	405	31	Percutaneous Coronary Interventions	253	48	Deep Vein Thrombosis	171
15	Diabetes Mellitus	396	32	Thrombosis	246			
16	Heart Muscle Injury	383	33	Resuscitation	244			
17	Diagnostic Images	363	34	Heart Injury	234			

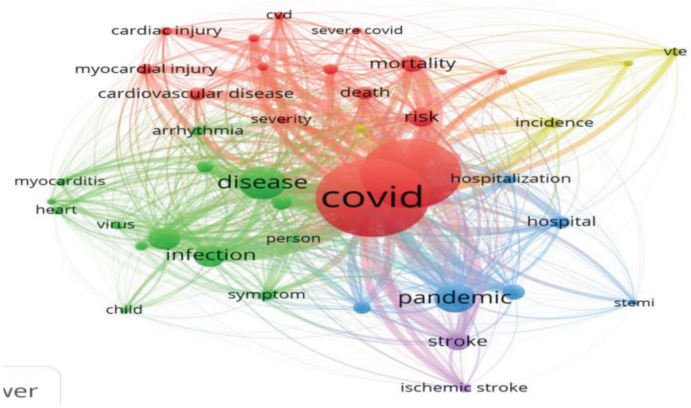

Figure 2: Network visualization map of co-occurrence of keywords.

5270 articles are published in 642 journals: 357 journals published 1-5 papers each, 194 journals 6-10 papers each, 62 journals 11-20 papers each, 23 journals 21-50 papers each, and 6 journals 51-85 papers each. The top 25 journals individually published 33 to 85 papers each and together published 22.92% share (1208 papers) in global output. The top 8 most productive journals are: *Arquivos Brasleiro De Cardiologia* (48 papers). The top 8 most impactful journals in terms of citations per paper are: *JAMA Cardiology* (154.23), *Journal of the American College of Cardiology* (54.99), *Circulation* (43.54), *Cardiovascular Research* (34.15), *European Heart Journal* (28.22), *Stroke* (25.45), *Journal of Thrombosi and Thrombolysis* (17.31) and *Heart* (13.1).

High-Cited Papers

Out of 5298 global publications on "Covid-19 and Heart Diseases", only 110 (2.08%) publications (assumed as highly cited here) received 100 to 1728 citations since their publication and together received 34332 citations, averaging 312.11 citations per paper. Amongst 110 high-cited publications, 56 papers received 100 to 195 citations, 24 papers 201-299 citations, 11 papers 311 to 479 citations, 15 papers 505 to 996 citations and 4 papers 1221 to 1728 citations.

Among 110 high-cited papers, the largest number of contribution (46 papers) comes from USA, followed by China and Italy (27 papers each), U.K. (13 papers), Germany and France (9 papers each), Netherland and Spain (6 papers each), Greece (4 papers), Austria and Switzerland (3 papers each), Australia, India and Poland (2 papers each), etc.

These 110 high-cited papers (65 articles, 20 reviews, 11 letters, 10 notes, 2 each as editorials and notes) consist of 14 non-collaborative papers and 96 collaborative papers (73 national collaborative and 23 international collaborative)

Among 110 high-cited papers, the largest institutional contribution (10 papers) comes from Huazhong University of Science and Technology, China, followed by Tongji Medical College, China (9 papers), Harvard Medical School, USA. Brigham and Women's Hospital, USA and University of Pennsylvania, USA (7 papers each), INSERM, France (5 papers), Baylor College of Medicine, USA , Massachusetts General Hospital, USA and Universitat degli studi di Milano, Ita;y (4 papers each), etc.

The 110 high- cited publications on "Covid-19 and Heart Diseases" are published in 69 journals, with 9 papers in *JAMA Cardiology*, 8 papers in *Circulation*, 6 papers in *New England Journal of Medicine*, 5 papers in *Stroke*, 4 papers in *Journal of the American College of Cardiology*, 2 papers each in 7 journals each and 1 paper each in other journals.

Table 4: Profile of Top 10 Most Productive and 10 Most Impactful Organizations on "Covid-19 and Heart Diseases."

S.No	Name of the organization	TP	TC	CPP	HI	ICP	%ICP	RCI
Top 10 Most Productive Organizations								
1	Harvard Medical School, USA	178	5065	28.46	28	89	50.00	2.41
2	Brigham and Women's Hospital, USA	92	4847	52.68	26	64	69.57	4.47
3	Massachsetts General Hospital, USA	92	3465	37.66	20	42	45.65	3.19
4	INSERM, France	88	1681	19.10	19	29	32.95	1.62
5	Mayo Clinic, USA	83	932	11.23	16	38	45.78	0.95
6	Icahn School of Medicine at Mount Sinai, USA	82	3416	41.66	20	33	40.24	3.53
7	Clevland Clinical Foundation, USA	80	1005	12.56	17	42	52.50	1.07
8	University of Pennsylvania, USA	77	2787	36.19	20	38	49.35	3.07
9	Columbia University Irving Medical Center, USA	74	1466	19.81	22	21	28.38	1.68
10	Universita degli studi di Milano, Italy	73	1806	24.74	17	33	45.21	2.10
Top 10 Most Impactful Organizations								
1	New York Presbyterian Hospital, USA	47	5712	121.53	15	26	55.32	10.31
2	Tongji Medical College, China	60	3939	65.65	20	24	40.00	5.57
3	Huazong University of Science and Technology, China	68	4448	65.41	21	30	44.12	5.55
4	Brigham and Women's Hospital, USA	92	4847	52.68	26	64	69.57	4.47
5	Icahn School of Medicine at Mount Sinai, USA	82	3416	41.66	20	33	40.24	3.53
6	AP-HP Assistance Publique-Hopitaux de Paris, France	61	2360	38.69	14	26	42.62	3.28
7	Massachsetts General Hospital, USA	92	3465	37.66	20	42	45.65	3.19
8	University of Pennsylvania, USA	77	2787	36.19	20	38	49.35	3.07
9	University of Michigan, Ann Arbor, USA	54	1930	35.74	15	29	53.70	3.03
10	Imperial College London, USA	65	2101	32.32	16	34	52.31	2.74

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

Table 5: Profile of Top 10 Most Productive and 10 Most Impactful Authors on "Covid-19 and Heart Diseases".

S.No.	Name of the author	Affiliation of the author	TP	TC	CPP	HI	ICP	%ICP	RCI
Top 10 Most Productive Authors									
1	M.Metra	Universita degli studi di Brescia, Italy	23	2002	87.04	11	10	43.48	7.38
2	A.Harky	Liverpool Heart and Chest Hospital, U.K.	22	215	9.77	7	1	4.55	0.83
3	M.K.Chung	Cleveland Clinic Foundation, USA	15	306	20.40	7	12	80.00	1.73
4	A.M.Russo	Rowan University, Cooper Medical School, USA	14	289	20.64	8	13	92.86	1.75
5	S.Valente	Azienda Ospedaliera Universitaria Senese, Italy	14	33	2.36	3	2	14.29	0.20
6	C.J.Lavie	Ochsner Heart and Vasular Institute, USA	13	466	35.85	6	6	46.15	3.04
7	E.Mahmud	University of California, San Diego, USA	13	295	22.69	8	6	46.15	1.92
8	L.Roncon	Ospedale Santa Maria della Misericordia, Italy	13	27	2.08	3	1	7.69	0.18
9	S.Yaghi	NYU Langone Health, USA	13	451	34.69	9	5	38.46	2.94
10	E.Baldi	Universita degli studi di Pavia, Italy	12	377	31.42	5	3	25.00	2.66
Top 10 Most Impactfu;l Authors									
1	G.Y.H. Lip	University of Liverpool, U.K.	12	1376	114.67	5	12	100	9.73
2	A,J.Kirtane	Columbia University Irvine Medical Center, USA	12	1316	109.67	8	3	25	9.3
3	M.Metra	Universita degli studi di Brescia, Italy	23	2002	87.04	11	10	43.48	7.38
4	F.Crea	Universits Cattolica del Sacro Cuore, Campus di Toma, Italy	11	814	74	4	2	18.18	6.28
5	M.R.Mehra	Brigham and Women's Hospital, USA	12	763	63.58	7	4	33.33	5.39
6	M.Senni	Papa Giovanni XX111 Hospital, italy	12	457	38.08	7	4	33.33	3.23
7	C.J.Lavie	Ochsner Heart and Vasular Institute, USA	13	466	35.85	6	6	46.15	3.04
8	S.Yaghi	NYU Langone Health, USA	13	451	34.69	9	5	38.46	2.94
9	E.Baldi	Universita degli studi di Pavia, Italy	12	377	31.42	5	3	25	2.66
10	E.Mahmud	University of California, San Diego, USA	13	295	22.69	8	6	46.15	1.92

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

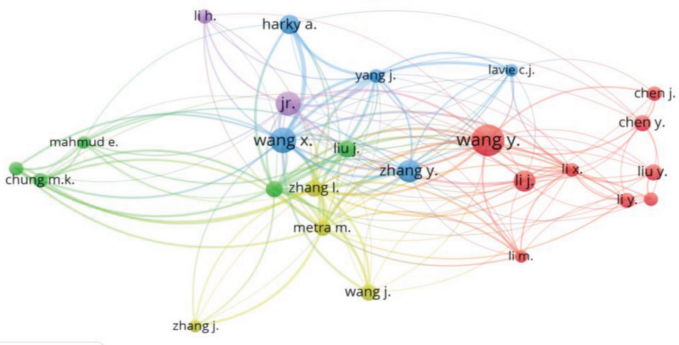

Figure 3: Network visualization map of Authors.

SUMMARY AND CONCLUSION

The 5298 global publications were published on "Covid-19 and Heart Diseases" as covered in Scopus database till 28.9.21. These 5298 global publications registered 62459 citations, averaging 11.79 citations per publication. Only 15.21% (806) of the total global publications received extramural funding support from 150+ research agencies and they these funded papers together received 15816 citations, averaging 19.62 citations per paper.

123 countries unevenly participated in 5298 global publications "Covid-19 and Heart DIseases", of which the top 10 countries together contributed 93.37% share and more than 100% share in global publications and citations. USA contributed the largest global share (33.16%), followed by Italy (13.34%), U.K. (10.4%), China (7.8%), etc. Four out of top 10 countries registered citations per paper and relative citation index higher than their group average average (17.63 and 1.50): China (35.31 and 2.99), France (23.01 and 1.95), Germany (23.0 and 1.95) and Italy (20.43 and 1.73) (19.74 and 1.23).

In all 1761 organizations and 2499 authors participated unevenly in global research on "Covid-19 and Heart Diseases", of which the top 25 organizations and authors together contributed 34.03% and 6.17% share and 90.11% and 16.88% share respectively share in global publications and citations.

The top 5 most productive organizations were: Harvard Medical School, USA (178 papers), Brigham and Women's Hospital, USA and Massachsetts General Hospital, USA (92 papers each), INSERM, France (88 papers) and Mayo Clinic, USA (83 papers). The top 5 most impactful organizations in terms of citations per paper and relative citation index were: New York Presbyterian Hospital, USA (121.53 and 10.31), Tongji Medical College, China (65.65 and 5.57), Huazhong UNiversity of Science and Technology, China (65.41 and 5.55), Brigham and Women's Hospital, USA (52.68 and 4.47) and Icahn School of Medicine at Mount Sinai, USA (41.66 and 3.53).

The top 5 most productive authors were: M. Metra IItaly) (23 papers), A.Harky (U.K.)(22 papers), M.K.Chung (USA)(15 papers), A.M.Russo (USA) and S.Valente (Italy)(14 papers each). The top 5 most impactful authors were: G.Y.H. Lip (U.K.)(114.67 and 9.73), A.J.Kirtane (USA) (109.67 and 9.3), M.Metra (Italy)(87.04 and 7.38), F.Crea (Italy)(74.0 and 6.28) and M.R.Mehra (USA)(63.58 and 5.39)

European Heart Journal (85 papers) was the most productive journal contributing on this theme, followed by *Circulation* (81 papers), *Stroke* (78 papers), *Journal of Stroke and Cerebrovascular Disease* (73 papers) and *Journal of Cardiac Surgery* (71 papers). *JAMA Cardiology* (154.23) was the most impactful journal in terms of citation per paper on this theme, followed by *Journal of the American College of Cardiology* (54.99), *Circulation* (43.54), *Cardiovascular Research* (34.15) and *European Heart Journal* (28.22).

Only 2.08% (110) publications received 100 to 1728 citations which together registered 34332 citations, averaging 648.02 citations per paper. Among 110 high-cited papers, USA contributed the the largest number (46) of papers, followed by China and Italy (27 papers each), U.K. (13 papers), Germany and France (9 papers each), Netherland and Spain (6 papers each), Greece (4 papers), Austria and Switzerland (3 papers each), Australia, India and Poland (2 papers each), etc.

Conclude that the overview of bibliometric research on "Covid-19 and Heart Diseases" presented above have identified the status of current research and given clues about future research areas to be chosen. Such a analysis tmay be useful to the research community and decision-makers to prioritize research needs and identify leading Covid-19 researchers, countries, institutes and authors working in this area. Given the enormous burden posed by this illness and the significant adverse prognostic impact of cardiac involvement, further research is required to understand the incidence, mechanisms, clinical presentation and outcomes of various CV manifestations in Covid-19 patients.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Article History: Received: 24-08-2021; Revised: 05-10-2021; Accepted: 10-11-2021.
Cite this article: Gupta BM, Surulinathi M, Bansal J, Bansal M. Covid-19 and Heart Diseases: A Scientometric Assessment of Global Publications during 2020-21. J Young Pharm. 2021;13(3) Suppl:s78-s83.