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Covid-19 and Kidney Disease: A Bibiometric Assessment of Global Literature

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The study presents an assessment of worldwide research trends on the 'Covid-19 and Kidney Disease' based on publications indexed in Scopus database till 1st December 2021. The publications and citations data were statistically analysed on various bibliometric indicators such as document type, subject area, keywords, authors collaboration, author impact, country production, citations and co-citations patterns, collaboration patterns, etc. through bibliometrix tool and R package (Biblioshiny), and spreadsheet. The study identified and analysed 1673 documents (with 22.12% share externally funded) on this topic which received 17407 citations with the participation of 571 organisations and 1366 authors from 93 countries and published in 291 journals. Adults, middle aged and the aged constituted the largest share (42.02%, 30.42% and 26.60%) of publications studied on this topic. Treatment, clinical studies, complications and risk factor constitute the largest share (42.02%, 41.48%, 25.1% and 18.35%) of publications on this topic. The USA and China lead in global publication output (with 471 and 162 papers) and China (28.36 and 2.73) and Italy (21.22 and 2.04) lead in global citation impact. The INSERM, France and Icahn School of Medicine at Mount Sinai, USA lead in publications productivity (with 46 and 45 papers) and Tongji Medical College, China (70.1 and 7.14) and Huazhong University of Science and Technology, China (70.10 and 6.74) lead in citation impact. S. Mohan and S.Caillard lead in publication productivity (with 20 and 18 papers), and C.Ronoco (48.19 and 4.61) and P.Cravedi (34.27 and 3.30) lead in citation impact. *American Journal of Transplantation* and *Kidney International* lead in global publication output (with 67 and 59 papers) *and Kidney International* (65.78) and *Journal of American Society of Nephrology* (52.56) lead in citation impact. The most significant keywords found on this theme are Coronivirus 19, Covid 19, SARS-CoV-2, Acute Kidney Failure,

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Acute Kidney Injuries, Kidney Transplantation, etc. The research sheds light on global research on the Covid-19 and Kidney disease research complications.

Keywords: *Kidney, Renal, Covid-19, SARS-CoV-2, Coronavirus, Bibliometric, Scientometrics.*

1 INTRODUCTION

The coronavirus disease 2019 (Covid-19) pandemic has strained medical systems globally. The disease results from infection with severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), and it results in multi-organ injury including the kidneys. The disease has unique implications for patients developing acute kidney injury (AKI), as well as patients with chronic kidney disease (CKD) or end stage kidney disease (ESKD), kidney transplant recipients (KTR) and Glomerulonephritis (GN) [1].

The incidence of AKI in patients with Covid-19 is variable across numerous international studies, but the high incidence of AKI and its associated worse outcomes in the critical care setting are a consistent finding. A multitude of patterns and mechanisms of AKI have been elucidated, and novel strategies to address shortage of renal replacement therapy equipment have been implemented. The disease also has had consequences on longitudinal management of patients with chronic kidney disease and end stage kidney disease. Kidney transplant recipients may be especially susceptible to Covid-19 as a result of immuno suppression, with preliminary studies demonstrating high mortality rates. Increased surveillance of disease with low threshold for testing and adjustment of immunosuppression regimen during acute periods of illness have been recommended [2] .

2 LITERATURE REVIEW

Several bibliometric studies were conducted on Covid- 19 [3-4] and kidney related diseases [6-11], but no bibliometric study exists on 'Covid-19 and kidney disease' at both national and international level. Therefore, the present study is undertaken to examine global literature on impact of Covid-19 in Kidney diseases. The main focus here is: (i) to study the characterstics and trends in global literature, (ii) to identify the broad and narrow subject areas and significant keywords, (iii) to identify leading players (countries, organisations and authors), involved in research and (iv) to identify leading media of communication and (v) to study the characterstics of high-cited papers.

3 MATERIALS AND METHODS

To perform the study on global publications on 'Covid-19 and Kidney Diseases', the well-known multidisciplinary citation and bibliographic database Scopus (http://www.scopus.com) was used as the primary source of indexed publications. A search strategy was developed where the primary keywords related to 'Covid-19' and 'Kidney" were used in 'Keyword' and 'Title' tags of Scopus database. The search was performed on 10th December 2021, and records indexed up to this date were included in the study. This search led to the identification of 1673 documents globally

in the overall category. Scopus database allows downloading the bibliographic data in various formats. For this work, the data was downloaded in the CSV and Bibtex file format. The statistical tools, R (bibliometrix package) and spreadsheets were used to present the study results for data analysis.

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 (kidney* or renal*)

4 ANALYSIS AND RESULTS

41 OVERALL OUTPUT

In all 1673 (2020=623; 2021=1045 and 2022=5) global publications were published on 'Covid-19 and Kidney Disease' as reported in Scopus database till 10 December 2011. The 1673 global publications reported 17407 citations, averaging 10.40 ciations per paper. Of the total global publications, 22.12% (370 publications) share received external funding support. These 370 funded papers received 6969 citations, averaging 18.83 citations per paper. The major funding agencies (along with their output) are Natural National Foundation of China (64 papers), National Institute of Health (60 papers), National Institute of Diabetes and Digestive and Kidney Diseases (59 papers), Deutche Forschungsgemeinschaft (16 papers), National Center for Advanced Translational Sciences (15 papers), AstraZeneca (13 papers), U. S. Department of Health and Human Sciences (13 papers), Baxter International (12 papers), etc. Of the 1673 global publications, articles constitutes the largest share (61.21% share), followed by letters (14.70% share), reviews (13,63% share), notes (4.36% share), editorials (4.18% share), erratum (1.08% share), short surveys (0.48% share), book chapters (0.24% share) and conference papers (0.12% share).

Of the total population studied among 1673 global papers, adults constituted the largest group (39.57% share), followed by middle aged (30.42% share), aged (26.60% share), adolescents (3.71% share) and children (1.97% share).

In terms of type of studies reported globally, treatment accounts for the largest publication share (42.02%), followed by clinical studies (41.48%), complications (25,16%), risk factors (18.35%), epidemiology (15.42%) , pathophysiology (14.17%) and genetics (4.0%). There is an overlap of papers among different type of studies also.

42 TOP 15 MOST PRODUCTIVE COUNTRIES

In all, 93 countries participated in global research on 'Covid-19 and Kidney Disease': 45 countries contributed 1-5 papers each, 14 countries, 6-10 papers each, 22 countries, 11-50 papers each, 6 countries, 51-100 papers each and 6 countries, 101-471 papers each. The top 10 countries individually published 67 to 471 papers and together contributed 1431 papers and 21908 citations, constituting 85.53% and 100.0% share of global publications and citations. On further analysis, it was observed that: (i) Two countries published more than the average group productivity (167.3) of top 10 countries: USA (471 papers) and China (162 papers); (ii) Three countries registered citations per paper and relative citation index more than the group average (15.31 and 1.47) of top 10 countries, viz., China (28.36 and 2.73), Italy (21.22 and 2.04) and Spain (20.83 and 2.0). The share of international collaborative papers of top 10 countries varied from 14.93% to 46.53%, with an average of 32.98%.

Table 1. Bibliometric Profile of Top 10 Most Productive Countries on 'Covid-19 and Kidney Disease'

S.No	Name of the country	TP	TC	CPP	HI	ICP	%ICP	RCI	TCL
1	USA	471	6855	14.55	38	146	31.00	1.40	481
2	China	162	4594	28.36	23	31	19.14	2.73	80
3	Italy	147	3120	21.22	30	68	46.26	2.04	237
4	U.K.	144	1272	8.83	16	67	46.53	0.85	124
5	France	101	1426	14.12	20	31	30.69	1.36	124
6	India	101	639	6.33	11	35	34.65	0.61	99
7	Germany	86	1068	12.42	14	32	37.21	1.19	142
8	Spain	80	1666	20.83	23	24	30.00	2.00	117
9	Brazil	72	855	11.88	9	28	38.89	1.14	113
10	Turkey	67	409	6.10	10	10	14.93	0.59	60
	Total of 10 countries	1431	21904	15.31	19.4	472	32.98	1.47	1577
	Global total	1673	17407	10.40			0.00	1.00	
	Share of top 10 countries in global total	85.53							

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

Figure 1 shows the collaboration network map of top 50 countries based on their number of publications and collaborations between them developed using VOSviewer software. The distance between the two countries indicates how closely the two countries are linked in terms of research. The size of the circle (country) represents the frequency of their occurrence. All these countries are divided into 7 clusters shown in different colours.

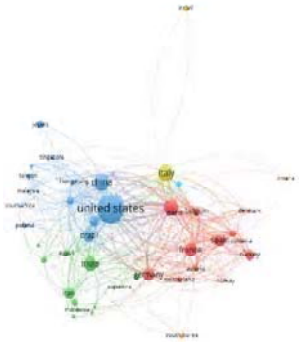

Figure 1: Country Collaboration Network

43 SUBJECT-WISE DISTRIBUTION

According to Scopus defined subject categories, the global output on 'Covid-19 and Kidney Disease' may be classified under four major sub-fiels and Medicine journals reported the largest publication share (92.43%), followed by Biochemistry, Genetics and Molecular Biology (8.07% share, Immunology and Microbiology (4.66% share) and Pharmacology, Toxicology & Pharmaceutics (3.35% share). In terms of impact, Medicine registered the highest citations per paper and Pharmacology, Toxicology and Pharmaceutics the least (3.07).

Table 2. Subject-Wise Distribution of Global Papers on "Covid-19 and Kidney Disease"

S.No	Name of the subject	TP	TC	CPP	%TP
1	Medicine	1546	6955	4.50	92.41
2	Biochemistry, Genetics & Molecular Biology	135	606	4.49	8.07
3	Immunology & Microbiology	78	321	4.12	4.66
4	Pharmacology, Toxicology & Pharmaceutics	56	172	3.07	3.35
	Global total	1673	17407	10.40	100.00

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

431 SIGNIFICANT KEYWORDS

We typically find two types of keywords in academic research papers: *keyword plus* and *author's keywords*. Databases use the keyword plus feature to standardise keywords, and authors use the author's keyword feature to convey essential concepts. Through the bibliometric tool, the authors extracted 26 significant keywords from document title and abstract shown in Table 3. The keyword co-occurrence in research

publications serves as secondary support for insight into main topics and research trends in the Covid-19 and Kidney Disease. Figure 2 (*Keywords plus*) and Figure 3 (*Author's Keywords*) is generated through the Biblioshiny web interface application of top 50 keywords shows the networks map of keyword co-occurrences by authors and document title keywords at a glance. The keywords sizes represent the frequency of their occurrence in the author's keywords and document title keywords. The most Significant keywords are indicated along with their frequency of occurrence, such as Coronavirus 19 (1160), Covid 19 (1101), SARS-CoV-2 (659), Acute Kidney Failure (631), Acute Kidney Injuries (541), Kidney Transplantation (527)', etc. The links between the keywords show that these keywords co- occur in the literature.

Table 3. List of Significant Keywords

S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency
1	Coronovirus 19	1160	15	End Stage Renal Disease	162
2	Covid-19	1101	16	Transplant Receipients	162
3	SARS-CoV-2	659	17	Diabetes Mellitus	160
4	Acute Kidney Failure	631	18	Chronic Renal Insuffiency	114
5	Acute Kidney Injuries	541	19	Chronic Kidney Disease	106
6	Kidney Transplantation	527	20	Renal Dialysis	99
7	Chronic Kidney Failure	384	21	Continuos Renal Replacement Therapy	96
8	Hemodialisis	290	22	Kidney Failure	92
9	Renal Replacement Therapy	253	23	Peritoneal Dialysis	89
10	Immunosuppressive Treatment	249	24	Kidney Biopsy	85
11	Intensive Care Unit	242	25	Graft Rejection	80
12	Kidney Graft	178	26	Kidney Injury	76
13	Kidney Disease	175			
14	Kidney Function	163			

Figure 2: WordCloud Plot based on Keywords Plus

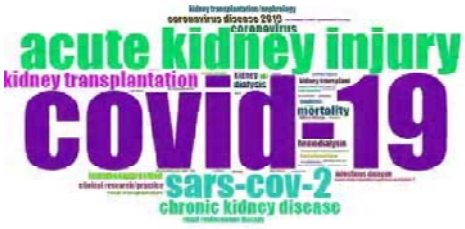

Figure 3: Word Cloud Plot based on Author's Keywords

44 MOST PRODUCTIVE ORGANISATIONS

In all 571 organisations participitated in global research on 'Covid-19 and Kidney Disease', 347 organisations contributed 1-5 papers each, 155 organisations 6-10 papers each, 58 organisations 11-20 papers each and 11 organisations 21-45 papers each. The top 15 organisations individually published 19-46 papers each and together contributed 427 papers and 12903 citations, constituting 25.52% and 74.12% share of global publications and citations, respectively. On further analysis, it was observed that: (i) Five organisations have contributed more than the average group productivity (28.7) of top 15 organisations viz., INSERM, France (46 papers), Icahn School of Medicine at Mount Sinai, USA (45 papers), Tongji Medical College, China and Huazhong University of Science and Technology, China (42 papers each) and AP-HP Assistance Publique-Hopitaux de Paris, France (37 papers); (ii) Five organisations have registered citations per paper and relative citation index more the group average (30.22 and 2.91) of top 15 organisations: Tongji Medical College, China (70.1 and 7.14), Huazhong University of Science and Technology, China(70.10 and 6.74), University degli Studi di Padova, Italy (43.21 and 4.15), Albert Einstein College of Medicine at Yeshiva University, USA (42.48 and 4.08) and Hospital Clinic Barcelona, Spain (37.10 and 3.57).(Table 2)

Table 4. Bibliographile Profile of Top 15 Organisations

S.No	Name of the Organisation	TP	TC	CPP	HI	ICP	%ICP	RCI
1	INSERM, France	46	871	18.93	16	13	28.26	1.82
2	Icahn School of Medicine at Mount Sinai, USA	45	554	12.31	10	14	31.11	1.18
3	Tongji Medical College, China	42	2944	70.10	13	3	7.14	6.74
4	Huazhong UNiversity of Science & Technology, China	42	2944	70.10	13	3	7.14	6.74
5	AP-HP Assistance Publique-Hopitaux de Paris, France	37	727	19.65	12	9	24.32	1.89
6	Brigham & Women's Hospital, USA	27	621	23.00	8	17	62.96	2.21
7	Harvard Medical School, USA	25	469	18.76	8	15	60.00	1.80
8	Albert Einstein College of Medicine at Yeshiva University, USA	21	892	42.48	11	5	23.81	4.08
9	Massachusetts General Hospital, USA	21	366	17.43	8	4	19.05	1.68
10	Columbia University, USA	21	457	21.76	8	4	19.05	2.09
11	Hospital Clinic Barcelona, Spain	21	779	37.10	12	5	23.81	3.57
12	John Hopkins School of Medicine, USA 20	20	204	10.20	8	3	15.00	0.98
13	Weill Cornel Medicine, USA	20	184	9.20	2	4	20.00	0.88
14	Imperial College London, U.K.	20	70	3.50	5	7	35.00	0.34
15	Universita degli Studi di Padova, Italy	19	821	43.21	7	14	73.68	4.15
	Total of 15 organizations	427	12903	30.22	8	120	28.10	2.91
	Global total	**1673**	**17407**	10.40	9.4			
	Share of top 15 organizations in global total	25.52	74.12					

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

45 TOP 15 MOST PRODUCTIVE AUTHORS

In all, 1366 authors participitated in global research on 'Covid-19 and Kidney Disease', 1268 authors contributed 1-5 papers each, 86 authors 6-10 papers each and 12 authors 11-20 papers each. The top 15 authors individually published 10-20 papers each and together contributed 196 papers and 3847 citations, constituting 11.72% and 22.10% share of global publications and citations, respectively. On further analysis, it was observed that: (i) Five authors have contributed more than the average group productivity (13.06) of top 15 authors: S. Mohan (20 papers), S.Caillard (18 papers), V.B.Kute (17 papers), C.Ronoco (16 papers) and M. Crespo;

(ii) Eight authors have registered citations per paper and relative citation index more the group average (19.63 and 1.89) of top 15 authors: C.Ronoco (48.19 and 4.61), P.Cravedi (34.27 and 3.30), B.Moulin (29.0 and 2.79), S.Fabi-Kremer (25.08 and 2.41), S.Mohan (23.35 and 2.25), T. Benotma (20.50 and 1.97), P.Perrin (20.40 and 1.96) and M. Crespo (19.79 and 1.90) (Table 2)

Table 5. Bibliometric Profile of Top 15 Authors on 'Covid-19 and Kidney Disease'

Name of the author	Affilaition of the author	TP	TC	CPP	HI	ICP	%ICP	RCI
S. Mohan	Columbia University, USA	20	467	23.35	8	4	20.00	2.25
S. Caillard	Les Hopitaux Univeritaires de Strasbourg, France	18	352	19.56	9	1	5.56	1.88
V.B. Kute	Dr HL Trivedi Institute of Transplantation Sciences, IKDRCC-ITS, Ahmedabad	17	82	4.82	6	0	0.00	0.46
C. Ronoco	Ospedale San Bortola, Italy	16	771	48.19	7	13	81.25	4.63
M. Crespo	Hospital del Mar, Spain	14	277	19.79	8	3	21.43	1.90
H.S. Mesham	Dr HL Trivedi Institute of Transplantation Sciences, IKDRCC-ITS, Ahmedabad, India	13	28	2.15	3	0	0.00	0.21
T. Benotma	Les Hopitaux Univeritaires de Strasbourg, France	12	246	20.50	8	0	0.00	1.97
S. Fabi - Kremer	Les Hopitaux Univeritaires de Strasbourg, France	12	301	25.08	8	0	0.00	2.41
S. Chauhan	Dr HL Trivedi Institute of Transplantation Sciences, IKDRCC-ITS, Ahmedabad, India	11	28	2.55	3	0	0.00	0.24
P. Cravedi	Icahn School of Medicine at Mount Sinai, USA	11	377	34.27	6	8	72.73	3.30
K. Kalantar - Zadeh.	UCI School of Medicine, USA	11	46	4.18	4	4	36.36	0.40
B. Moulin	Les Hopitaux Univeritaires de Strasbourg, France	11	319	29.00	8	0	0.00	2.79
D. Anglicheau	Hopital Necker Enfants Malades, France	10	172	17.20	5	1	10.00	1.65
S.A. Husain	Columbia University, USA	10	177	17.70	6	1	10.00	1.70
P.Perrin	Hopital Necker Enfants Malades, France	10	204	20.40	7	0	0.00	1.96
	Total of top 15 authors	196	3847	19.63	96	35	17.86	1.89
	Global total	**1673**	**17407**	10.40				
	Share of top 15 authors in global total	11.72	22.10	1.89				

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

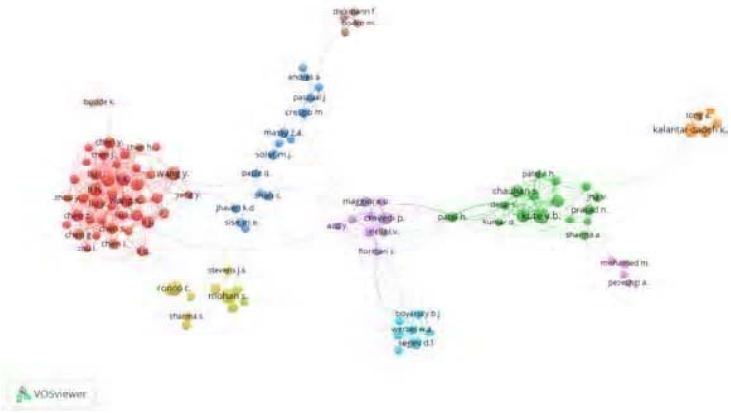

Figure 4: Author's Collaboration Network

Figure 4 shows the collaboration network map of top authors based on their number of publications and collaborations between them developed using VOSviewer software. The size of the circle (authors) represents the frequency of their occurrence. The distance between the two authors indicates how closely the two authors are linked in terms of research. All these authors are divided into 10 clusters present in different colours.

46 TOP 15 JOURNALS

Of the 1673 global papers on ' Covid-19 and Kidney Disease', 1666 are published in 291 journals, 4 in book series, 2 as books and 1 in trade journal. Of the 291 journals, 228 journals published 1-5 papers, 32 journals 6-10 papers each, 16 journals 11-20 papers each, 12 journals 21-50 papers each and 3 journals 51-67 papers each.

The top 15 journals individually published 22 to 67 papers and together contributed 529, constituting 31.75% share of global papers in journals. Top 6 most productive journals are *American Journal of Transplantation (67 papers), Kidney International (59 papers), Transplant Infectious Disease (54 papers), Kidney International Reports (45 papers), Journal of Nephrology (33 papers)* and *Transplantation Proceedings (33 papers)*. The top 6 journals in terms of citations per paper are: *Kidney International* (65.78), *Journal of American Society of Nephrology* (52.56), *American Journal of the Transplantation* (27.67), *American Journal of Kidney Disease* (13.64), *Kidney International Reports* (12.98) *and Journal of Clinical Medicine* (11.48).

Table 6. List of Top 15 Most Productive Journals on 'Covid-19 and Kidney Disease'

S.No	Name of the Journal	TP	TC	CPP
1	American Journal of Transplantation	67	1854	27.67
2	Kidney International	59	3881	65.78
3	Transplant Infectious Disease	54	421	7.80
4	Kidney International Reports	45	584	12.98
5	Journal of Nephrology	33	201	6.09
6	Transplantation Proceedings	33	97	2.94
7	Journal of American Society of Nephrology	32	1682	52.56
8	Journal of Clinical Medicine	31	356	11.48
9	PLOS One	28	120	4.29
10	Transplantation	27	206	7.63
11	Clinical Journal of the American Society of Nephrology	26	298	11.46
12	American Journal of Kidney Disease	25	341	13.64
13	Frontiers in Medicine	24	116	4.83
14	Clinical Transplantation	23	79	3.43
15	Transplant International	22	76	3.45
	Total of top 15 journals	529	10312	19.49
	Global total in journnals	`1666		
	Share of top 15 journals in global total	31.75		

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

47 HIGH CITED PAPERS

Out of 1673 publications on 'Covid-19 and Kidney Disease', only 34 publications (2.3%) received 100 to 1131citations and they together received 7887 citations, averaging 231.97 citations per paper. These are assumed here as high-cited publications. Among 1673 publications, 19 are in citation range 100-190, 9 in citation range 203-237, 3 in citation range 302-387, 2 in citation range 491-713 and 1 received 1131 citations.

18 countries participated in these 34 high-cited publications, of which USA contributed 16 publications, followed by Italy (11 publications), China (9 publications), Spain (5 papers), France and Germany (4 publications each), Brazil (3 publications), Belgium, Canada, Netherlands and U.K. (2 publications each), Austria, India, Romania, South Africa, Taiwan, Thailand and Switzerland (1 paper each).

The 34 high-cited publications (comprised 16 articles, 7 reviews, 5 each, notes and letters and 1 editorial) consist of 2 non-collaborative publications and 32 collaborative (22 national and 10 international) publications.

The 34 high-cited publications involve the participation of 196 organisations

and 434 authors. The leading organisations participating in these high-cited publications are: Huazhong University of Science and Technology, China, Tongji Medical College, China and Albery Einstein College of Medicine at Yeshiva University, USA (5 publications each), Universita degli Studi di Padova, Italy (4 publications), Briham and Women's Hospital, USA and Hospital Clinic Barcelona (3 publications each), INSERM, France, Icahn School of Medicine at Mount Sinai, USA, AP-HP Assistance Publique- Hopitaux de Paris, France, Harvard Medical School, USA and Columbia University, USA (2 publications each), etc.

The 34 high-cited publications are published in 16 journals, with 7 publications each are published in *Kidney International* and *Journal of the American Society of Nephrology*, 5 publications in *American Journal of Transplantation*, 2 publications each in *Kidney International Reports, Intensive Care Medicine* and 1 publication each in *American Journal of Nephrology, Critical Care, European Urology, International Urology & Nephrology, JCI Insights, Journal of Clinical Medicine, The Lancet, Lancet Respiratory Medicine* and *New England Journal of Medicine*.

5 SUMMARY AND CONCLUSION

Kidney disease has a significant impact on global health as a leading source of morbidity and mortality worldwide and a substantial risk factor for cardiovascular disease. Post-Covid 19 effects on different parts of the body and organs complications are coming to the picture and extensive effects on virtually all the organs are yet to come out. Several research studies have shown that the Covid-19 virus has mainly affected the lungs, but its effects are also witnessed on the liver, kidney, eye, skin, mental health, heart and brain. This study presents a comprehensive bibliometric assessment of the impact of Covid- 19 on kidney diseases.

Using Scopus database, 1673 global publications are identified and studied on 'Covid-19 and Kidney Disease' till 10 December 2011. The 1673 global publications registered an 10.40 ciations per paper, with about 22.12% publication share receiving external funding support and averaging 18.83 citations per paper. Among the 1673 global papers studied, adults constituted the largest group (39.57% share), followed by middle aged (30.42% share), aged (26.60% share), adolescents (3.71% share) and children (1.97% share). Treatment among type of studies, accounts for the largest publication share (42.02%), followed by clinical studies (41.48% share), complications (25,16% share), risk factors (18.35% share), epidemiology (15.42%), pathophysiology (14.17% share) and genetics (4.0% share).

93 countries participated in global research on 'Covid-19 and Kidney Disease', with USA (471 papers) and China (162 papers) leading in global output and China (28.36 and 2.73), Italy (21.22 and 2.04) and Spain (20.83 and 2.0) leading in global impact in terms of citations per paper and relative citation index.

Medicine accounted for the largest share (92.43%) of the global output, followed by Biochemistry, Genetics and Molecular Biology (8.07% share), Immunology and Microbiology (4.66% share) and Pharmacology, Toxicology and Pharmaceutics (3.35% share). The most significant keywords (with their frequency of occurrences) on 'Covid-19 and Kidney Disease' are Coronivirus 19 (1160), Covid

19 (1101), SARS-CoV-2 (659), Acute Kidney Failure (633), Acute Kidney Injuries (541), Kidney Transplantation (527), etc.

In all, 571 organisations and 1366 authors participated in global research on 'Covid-19 and Kidney Disease', of which the top 15 organisations together constituting 25.52% and 11.72% and 74.12% and 22.10% respectively share of global publications and citations..

The top 5 leading organisations were INSERM, France (46 papers), Icahn School of Medicine at Mount Sinai, USA (45 papers), Tongji Medical College, China and Huazhong University of SCience & Technology, China (42 papers each) and AP-HP Assistance Publique-Hopitaux de Paris, France (37 papers). The five most impactful organizations were Tongji Medical College, China (70.1 and 7.14), Huazhong University of Science & Technology, China(70.10 and 6.74), University degli Studi di Padova, Italy (43.21 and 4.15), Albert

Einstein College of Medicine at Yeshiva University, USA (42.48 and 4.08) and Hospital Clinic Barcelona, Spain (37.10 and 3.57).

The top 5 most productive authors were S. Mohan (20 papers), S.Caillard (18 papers), V.B.Kute (17 papers), C.Ronoco (16 papers) and M. Crespo. THe top 5 most impactful authors were C.Ronoco (48.19 and 4.61), P.Cravedi (34.27 and 3.30), B.Moulin (29.0 and 2.79), S.Fabi-Kremer (25.08 and 2.41) and S.Mohan (23.35 and 2.25)

In all 291 journals partcipitated in global research on ' Covid-19 and Kidney Disease', of which the top 15 journals contributed 31.75% share of global papers in journals. The top 5 most productive journals were *American Journal of Transplantation (67 papers), Kidney International (59 papers), Transplant Infectious Disease (54 papers), Kidney International Reports (45 papers) and Journal of Nephrology (33 papers).* The top 5 journals in terms of citations per paper are: *Kidney International* (65.78), *Journal of American Society of Nephrology* (52.56), *American Journal of the Transplantation* (27.67), *American Journal of Kidney Disease* (13.64) and *Kidney International Reports* (12.98).

Only 34 (2.3%) publications out of 1673 publications on 'Covid-19 and Kidney Disease', only 34 publications received 100 to 1131 and they together received 7887 citations, averaging 231.97 citations per paper. 18 countries participated in these 34 high-cited publications, of which USA contributed 16 publications, followed by Italy (11 publications), China (9 publications), Spain (5 papers), France and Germany (4 publications each), Brazil (3 publications), etc. The 34 high-cited publications (comprised 16 articles, 7 reviews, 5 each notes and letters and 1 editorial) consist of 2 non-collaborative publications and 32 collaborative (22 national and 10 international). The 34 high-cited publications involve the participation of 196 organizations and 434 authors. The leading organizations participating in these high-cited publications are: Huazhong University of Science & Technology, China, Tongji Medical College, China and Albery Einstein College of Medicine at Yeshiva University, USA (5 publications each), Universita degli Studi di Padova, Italy (4 publications), etc, Briham & Women's Hospital, USA and Hospital Clinic Barcelona (3 publications each), The 34 high-cited publications are published in 16 journals, with 7 publications each are published in *Kidney*

International and *Journal of the American Society of Nephrology*, 5 publications in *American Journal of Transplantation*, 2 publications each in *Kidney International Reports, Intensive Care Medicine* and 1 publication each in 9 other journals

The study will be helpful for researchers and information seekers working on Covid-19 and renal complications to better understand the global scenarios of scientific research in this topic.

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