Vol. 3, No. 2, 1-16. DOI: 10.47909/ijsmc.55

Pro-Metrics

ORIGINAL ARTICLE

United Arab Emirates (UAE): A scientometric assessment of Covid-19 publications

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ABSTRACT

Objective. The United Arab Emirates continues to undertake and sustain its research pursuits in Covid-19 as a matter of strategy, considering that the country is facing unique challenges in this area of research. The paper seeks to analyze UAE publications on Covid-19 research and describe its research trends.

Methodology. A literature search on UAE publications on Covid-19 was conducted using the Scopus database, limiting the search period for the study to December 1, 2019 - April 7, 2023. Data were retrieved and downloaded for analysis using Microsoft Excel and Scopus Citation Overview tools. VOSviewer software was used to provide creative visualization of the relationships across researchers, institutions, and journals that reported UAE publications.

Results. 48,1461 publications were published on Covid-19 from December 2019 till April 7, 2023. Of these, the UAE contributed 3402 publications, constituting 0.71% share of global output and registered 14.63 average citations per article (CPP). The 732 (21.52%) UAE papers had received external funding support, and another 2493 (73.28%) papers appeared through international collaboration with countries such as the U.K (n=556), USA (n=553), India (n=448), and Saudi Arabia (n=399). The leading UAE participating organizations in Covid-19 research include the University of Sharjah (n=619), United Arab Emirates University (n=520), and Zayed University (n=239). The organizations which made the most citation impact in terms of CPP and RCI include American University in the Emirates (40.54 and 3.34), Mohammed Bin Rashid University of Medical & Health Sciences (34.4 and 2.83), and Al Jalila Children's Specialty Hospital (31.88 and 2.62). The leading UAE participating authors in Covid-19 research include R. Halwani (n=83), Z. Umar (n=38), and Q. Hamid (n=37). The authors who made the most citation impact in terms of CPP and RCI include R. Halwani (52.61 and 4.33), H. Q. Al Shamsi (30.24 and 2.49) and A. S. Al Dhaheri (28.81 and 2.37). The most utilized channels of research communication in Covid-19 research include *PLOS One* (n=73), *International Journal of Environmental Research & Public Health* (n=46), and *Scientific Reports* (n=36). The journals which received the most citations for UAE papers on Covid-19 research include the *International Journal of Infectious Diseases* (30.56 CPP), *IEEE Access* (20.49 CPP), and *Frontiers in Psychiatry* (17.40 CPP).

Received: 02-04-2023. **Accepted:** 13-07-2023

Editor: Carlos Luis González-Valiente

How to cite: Gupta, B. M., Dhawan, S., & Kappi, M. (2023). United Arab Emirates (UAE): A scientometric assessment of Covid-19 publications. *Iberoamerican Journal of Science Measurement and Communication; 3*(2), 1-16. DOI: 10.47909/ijsmc.55

Conclusions. The study presents the current status of research and the publication trends in Covid-19 in the UAE, particularly its most used sources for research publication, most productive and most cited organizations and authors, and its most sought-after topics in Covid-19 research. Strengthening research collaboration between UAE and the Middle East countries and with the developed world countries will further help UAE improve the quality and quantity of its research on Covid-19 and help implement its Covid-19 policies in the region.

Keywords: Covid-19; United Arab Emirates; publications; scientometrics; bibliometrics.

INTRODUCTION

COVID-19, a novel coronavirus, has raised global health concerns because of the infectious nature of the disease. Secondly, it has been instrumental in unprecedentedly causing high morbidity and mortality worldwide (Zhu, 2020). On January 30, 2020, the WHO declared the Covid-19 outbreak a public health emergency of international concern. In March 2020, WHO characterized it as a pandemic disease. This was done to apprise all countries that Covid-19 is a severe disease and appeal to them to become proactive in detecting Covid-19 infection and preventing its spread (Wei et al., 2020). Globally, as of April 19, 2023, there have been 763,740,140 confirmed cases of Covid-19, including 6,908,554 deaths, reported to WHO (WHO Coronavirus, 2023).

Like other countries, the UAE also faced Covid-19 crisis, but it responded to public health emergencies swiftly and decisively (The National Newspaper, 2020). The UAE government implemented several measures to contain the disease, prevent its spread and treat infected patients requiring medical care (Bin & Moonesar, 2020). Through its national health authority [National Crisis and Emergency Management Authority (NCEMA)], it introduced a set of National Guidelines for Clinical Management and Treatment of Covid-19 (Al Kaabi et al., 2020). The UAE used polymerase chain reaction (PCR) tests in line with WHO guidelines (World Health Organization, 2020a,b) to detect the presence of SARS-CoV-2 RNA and confirm Covid-19 cases. The UAE directed and ensured that all its clinical laboratories acquire accreditation from the relevant accreditation bodies for this purpose (Gulf News, 2019).

Soon after the WHO declared Covid-19 [Abbreviation for Coronavirus Disease 2019] as a global health emergency in February 2020, the medical world started to witness a surge in the publication of research papers on Covid-19. The research publications focused on several dimensions of the disease, such as virus transmission, pathogenesis, detecting infection, containing, and preventing its outbreak and spread, and vaccine development and treatment [Del Carpio Orantes, 2019]. There has also been a notable increase in Covid-19-related publications from the Middle East and Gulf countries, particularly in the UAE, since the beginning of the pandemic (Zyoud, 2019a,b; ElHawary, 2020; Gupta et al., 2021; Fan et al., 2020). Besides, there has been a growing interest in applying bibliometric analysis tools and visualization techniques to discover publication activities and trends in emerging research areas (Odone et al., 2020; Zyoud, 2021; Saad et al., 2022; AlBloushi, 2022; Al-Duwaish, 2022; Al-Omari et al., 2022; Jose et al., 2022). Given these developments, it will be worthwhile to undertake a bibliometric study of the literature contributed by the UAE in Covid-19 to highlight its key and significant publication activities and identify its current research trends in the field. Keeping the above context in mind, the main objective of the present study is to provide a bibliometric analysis on Covid-19 related research in the United Arab Emirates using different bibliometric indicators. The study, in particular, will seek (i) to ascertain the global ranking of UAE publications and its share in the global output; (ii) to identify the significant organizations and authors and to study their collaborative linkages, (iii) to identify the essential media of research communication, and (iv) to study the characteristics of high-cited papers.

METHODOLOGY

The UAE publications data on Covid-19 was sourced from the Scopus database. The study applied keywords such as 'Covid-19' and its

related keywords and 'United Arab Emirates' to "TITLE-ABS-KEY" and "Affiliation Country" tags. The data search period was confined to December 1 2019 to April 7, 2023. The downloaded bibliographic information regarding retrieved documents included title, keywords, author name and affiliation, institutional names and addresses, collaboration and funding information, journal name, and citations received. The data analysis, including bibliometric indicators, was done using MS Excel and data visualization of co-authorship among organizations and authors using VOSviewer software version and, Biblioshiny (R Studio). The authors used a few quantitative and quality indicators, such as the number of papers, number of collaborative papers, number of citations received, citations per paper, relative citation index, etc., to measure the performance of UAE research in Covid-19.

As seen from the Scopus database, 4,81,461 publications appeared from December 2019 to April 7 2023. The top four world countries that lead the tally in Covid-19 research include the USA (n=115539 with 24% global share), the U.K. (n=47073, 0.78% share), China (n=43260, 8.99% share), and India (n=35279, 7.33%). Among the Middle East countries, Turkey leads the tally with its highest publications count (n=12052), followed by Iran (n=11517), Saudi Arabia (n=9100), Egypt (n=5671), Israel (n=4779), United Arab Emirates (n=3402), Jordan (n=2175), Iraq (n=1899), etc.

TITLE-ABS-KEY ("covid 19" OR "2019 novel coronavirus" OR "coronavirus 2019" OR "coronavirus disease 2019" OR "2019-novel CoV" OR "2019 nov" OR covid 2019 OR corvidae OR "corona virus 2019" OR ncov-2019 OR ncov2019 OR "nov 2019" OR 2019-ncov OR covid-19 OR "Severe acute respiratory syndrome coronavirus 2" OR "SARS-CoV-2") AND (LIMIT-TO (AFFILCOUNTRY , "United Arab Emirates"))

RESULTS

The United Arab Emirates (UAE) has been found to have contributed a total of 3402 publications on Covid-19 research since the Covid-19 outbreak. Its world share was 0.71%, not even 1%. The UAE witnessed an increasing trend in its annual research output from 406 in 2020 to 1163 in 2021 and 1493 in 2022. Since their publication, these 3402 UAE publications received up to 41321 citations, averaging 12.15 per paper (CPP).

Of 3402 UAE publications on Covid-19, 37.98% (1292) did not receive a single citation since their publication. The rest of the UAE output received 1 to 1194 citations per paper. As much as 50.56% share of the UAE output (1380) received citations in the range of 1-10 citations per paper, 17.61% (599) received in the range of 11-30 citations per paper, 4.88% (166) received in the range of 31-50 citations per paper. In addition, 3.09% (105) papers received high 51-99 citations per paper, and a very smaller 2.53% share of the UAE output (86 papers) received comparatively higher citations in the range of 101-1194 citations per paper. Of the 3402 UAE publications, 732 (21.52%) are the publications as output from external-funded research projects. These 732 papers received 14863 citations since publication, averaging 20.30 CPP. The funding agencies which support Covid-19 research in the UAE along with their output include United Arab Emirates University (n=103 papers), followed by University of Sharjah (n=103), King Saud University (n=63), Khalifa University of Science, Technology & Research (n=50), National Institute of Health (N=40), Al Jalila Foundation (n=35), New York University Abu Dhabi (n=33), Zayed University (n=31), American University Sharjah (n=24), National Institute of Allergy & Infectious Diseases (n=21), etc.

Of the 3402 UAE publications, 2493 (73.28%) were international collaborative papers (ICPs). These 2493 papers received 35954 citations since publication averaging 14.42 CPP. The UAE published most of its papers in collaboration with the U.K (556), followed by USA (n=553), India (n=448), Saudi Arabia (n=399), Egypt (n=348), Jordan (n=345), Pakistan (n=294), Australia (n=253), Canada (n=244), Malaysia (n=239), Italy (n=235), China (n=196), Turkey (n=173), Germany (n=170), France (n=163), etc. But such publications as were resulting from its collaboration with Canada received the highest 47.69 CPP, followed by Italy (47.64 CPP), Germany (47.42 CPP), etc. (Table 1).

No.	Collaborating country name	TP	TC	CPP	%TP
1	U.K	556	14724	26.48	22.30
2	USA	553	15431	27.90	22.18
3	India	448	8814	19.67	17.97
4	Saudi Arabia	399	10356	25.95	16.00
5	Egypt	348	8600	24.71	13.96
6	Jordan	345	6037	17.50	13.84
7	Pakistan	284	4163	14.66	11.39
8	Australia	253	9210	36.40	10.15
9	Canada	244	11637	47.69	9.79
10	Malaysia	239	3850	16.11	9.59
11	Italy	235	11195	47.64	9.43
12	China	196	9168	46.78	7.86
13	Turkey	173	5436	31.42	6.94
14	Germany	170	8061	47.42	6.82
15	France	163	7491	45.96	6.54
		4606	134173	29.13	184.76
		2493	35954	14.42	100.00
TP: Total publications; TC: Total citations; CPP: Citations per paper.					

Table 1. Distribution of UAE's ICP Output in Covid-19 Research by Country of Collaboration.

SUBJECT-WISE DISTRIBUTION

As per Scopus-based subject categories, Medicine accounted for the largest share (40.42%), followed by Computer Sciences, Social Sciences and Engineering (18.34%, 17.25%, and 12.70%, respectively), Business, Management & Accounting, Biochemistry, Genetics & Molecular Biology, Economics, Econometrics & Finance and Pharmacology, Toxicology & Pharmaceutics (from 7.20% to 9.64%), Immunology & Microbiology and Environment Science (6.47% and 6.03% respectively), Energy and Psychology (3.73% and 1.73% respectively) and Veterinary Science (0.56%). Psychology registered the highest citations impact (15.19 CPP) and Energy the least (4.88 CPP) (Table 2).

No.	Subject Name	TP	TC	CPP	%TP
1	Medicine	1375	18655	13.57	40.42
2	Computer Science	624	4145	6.64	18.34
3	Social Sciences	587	4413	7.52	17.25
4	Engineering	432	3166	7.33	12.70
5	Business, Management & Accounting	328	2042	6.23	9.64
6	Biochemistry, Genetics & Molecular Biology	326	4924	15.10	9.58
7	Economics, Econometrics & Finance	248	2674	10.78	7.29
8	Pharmacology, Toxicology & Pharmaceutics	245	1826	7.45	7.20
9	Immunology & Microbiology	220	2315	10.52	6.47
10	Environment Science	205	2555	12.46	6.03
11	Energy	127	620	4.88	3.73
12	Psychology	101	1534	15.19	2.97
13	Neurosciences	59	856	14.51	1.73
14	Veterinary Science	19	144	7.58	0.56
	UAE total	3402	41321	12.15	100.00
TP: Total publications; TC: Total citations; CPP: Citations per paper.					

Table 2. Subject-wise Break-up of UAE Publications on Covid-19.

MOST PRODUCTIVE & IMPACTFUL ORGANIZATIONS

Individually in the UAE, the top 30 organizations published 26 to 619 publications on Covid-19 research during the period under study. Their average citation count ranged from 2.08 CPP to 40.5 CPP. Among the top 30 organizations, nine out of top 30 contributed more than the average productivity (115.47), including University of Sharjah (n=619), United Arab Emirates University (n=520), Zayed University (n=239), Ajman University (n=232), Khalifa University of Science & Technology (n=192), Al Ain University (n=184), Mohammed Bin Rashid University of Medical & Health Sciences (n= 156), Cleveland Clinic Abu Dhabi (n=134) and Dubai Health Authority (n=116). Among the top 30 organizations, only nine registered comparatively higher citation impact in terms of citations per paper (CPP) and Relative Citation Index (RCI), above the average value (13.84 CPP and 1.14 RCI). These include American University in the Emirates (40.54 and 3.34), Mohammed Bin Rashid University of Medical & Health Sciences (34.4 and 2.83), Al Jalila Children's Specialty Hospital (31.88 and 2.620), Ministry of Health & Prevention, Abu Dhabi (29.24 and 2.41), University of Sharjah (17.16 and 1.41), United Arab Emirates University (16.77 and 1.38), NYU Abu Dhabi (16.63 and 1.37), Canadian University in Dubai (14.4 and 1.19) and University of Dubai (13.86 and 1.14) (Table 3).

No.	Name of the organization	TP	TC	CPP	RCI	HCP	TLS	Cluster
1	University of Sharjah	619	10624	17.2	1.4	17	210	Blue
2	United Arab Emirates University	520	8720	16.8	1.4	16	143	Red
3	Zayed University	239	3291	13.8	1.1	5	83	Yellow
4	Ajman University	232	1329	5.73	0.5	0	35	Green
5	Khalifa University of Science & Technology	192	1911	9.95	0.8	3	70	Red
6	Al Ain University	184	1365	7.42	0.6	1	30	Green
7	Mohammed Bin Rashid University of Medical & Health Sciences	156	5366	34.4	2.8	8	100	Blue
8	Cleveland Clinic Abu Dhabi	134	1789	13.4	1.1	2	36	Red
9	Dubai Health Authority	116	1243	10.7	0.9	0	92	Blue
10	Higher Colleges of Technology	106	332	3.13	0.3	0	5	Blue
11	Abu Dhabi University	103	952	9.24	0.8	0	27	Yellow
12	NYU Abu Dhabi	101	1680	16.6	1.4	3	8	Red
13	American University of Sharjah	100	1221	12.2	1	2	19	Red
14	Rashid Hospital	74	550	7.43	0.6	0	37	Lavender
15	Sheikh Khalife Medical City, SEHA, Abu Dhabi	72	779	10.8	0.9	1	58	Lavender
16	Gulf Medical University	63	375	5.95	0.5	0	19	Green
17	Canadian University in Dubai	52	749	14.4	1.2	2	7	Green
18	Tawam Hospital	49	465	9.49	0.8	1	33	Lavender
19	British University in Dubai	45	318	7.07	0.6	1	4	Yellow
20	American University in the Emirates	39	1581	40.5	3.3	2	7	Yellow
21	University of Wollongong in Dubai	34	158	4.65	0.4	0	5	Red
22	Ministry of Health & Prevention, Abu Dhabi	33	965	29.2	2.4	3	47	Blue
23	Dubai Medical College	31	134	4.32	0.4	0	9	Green
24	Sheikh Shakhout Medical City, Abu Dhabi	31	389	12.6	1	1	23	Lavender
25	Ras Al Khaimah Medical & Health Science University	29	59	2.03	0.2	0	18	Blue
26	University of Dubai	29	402	13.9	1.1	1	11	Green
27	Khalifa University College of Medicine & Health Sciences	28	87	3.11	0.3	0	81	Red
28	Dubai Hospital	27	273	10.1	0.8	0	12	Green
29	Abu Dhabi Public Health Center	26	161	6.19	0.5	0	31	Red
30	Al Jalila Children's Specialty Hospital	26	829	31.9	2.6	2	26	Blue

No.	Name of the organization	TP	TC	CPP	RCI	HCP	TLS	Cluster
	Total of top 30 organizations	3464	47936	13.8	1.1	71		
	UAE total publications	3402	41321	12.2				

TP: Total publications; TC; Total citations; CPP: Citations per paper; ICP: International collaborative publications; RCI; Relative citations index; TLS: Total link strength; HCP: High-cited papers

Table 3. Publication profile of top 30 UAE organizations in Covid-19 research.

DISTRIBUTION OF COLLABORATIVE LINKAGES ACROSS 30 ORGANIZATIONS

The collaborative papers count of an organization is a measure of its collaborative link strength. The total link strength (TLS) of all 30 organizations which collaborated on a one-to-many basis varied from 10 to 210. The University of Sharjah depicted a linkage strength of 210, followed by United Arab Emirates University (143 linkages), Mohammed Bin Rashid University of Medical & Health Sciences (100 linkages) Dubai Health Authority (92 linkages), Khalifa University of Science & Technology (70 linkages), Rashid Hospital (n=37) and Sheikh Khalife Medical City, SEHA, Abu Dhabi (23 linkages). The bilateral linkage strength of all such organizations which collaborated on one-to-one basis varied from 1 to 53. The institutional pair "University of Sharjah and United Arab Emirates University" depicted the largest collaborative linkages (57), followed by the institutional pair "Dubai Health Authority and Rashid Hospital" (40 linkages), "University of Sharjah and Mohammed Bin Rashid University of Medical & Health Sciences" (38 linkages), "University of Sharjah and Dubai Health Authority" (29 linkages), "Khalifa University of Science & Technology and Dubai Hospital" and Khalifa University of Science & Technology and Sheikh Khalife Medical City, SEHA, Abu Dhabi" (27 linkages each), "Khalifa University of Science & Technology and Khalifa University College of Medicine & Health Science" and " UAE University and Tawam Hospital" (26 linkages each), "Mohammed Bin Rashid University of Medical & Health Sciences and Dubai Health Authority" (25 linkages), "University of Sharjah and Al Ain University" (24 linkages), "University of Sharjah and Ajman University" (22 linkages), "UAE University and Sheikh Khalife Medical City, SEHA, Abu Dhabi (21 linkages), "UAE University and Zyed University" and "University of Sharjah and Khalifa University of Science & Technology (20 linkages each), "Mohammed Bin Rashid University of Medical & Health Sciences and Al Jalila Children's Hospital"(18 linkages), etc.

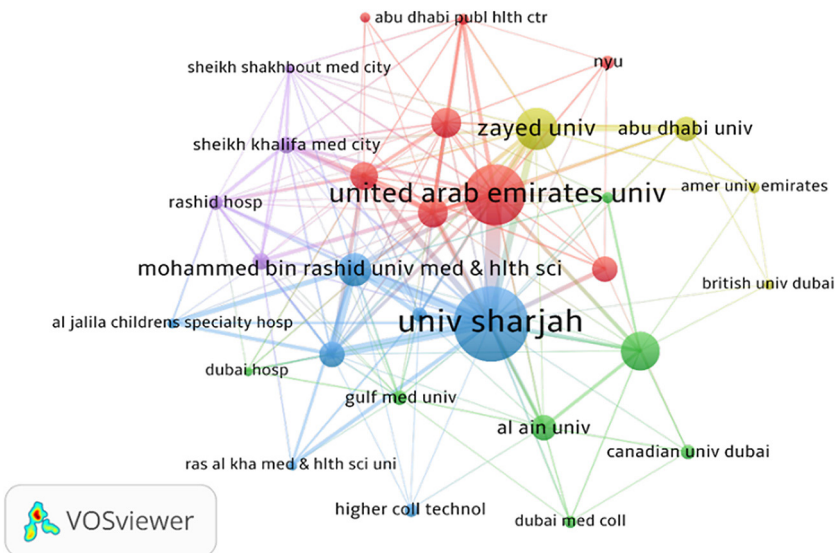

Figure 1. Top 30 UAE organizations in the collaboration network.

Figure 1 presents the collaborative network map of the top 30 organizations in five different clusters, each represented by a different color:

- Red Cluster (476 link strength, 9 organizations) includes Abu Dhabi Public Health Center, American University of Sharjah, Cleveland Clinic Abu Dhabi, Khalifa University College of Medicine & Health Sciences, Khalifa University of Science & Technology, NYU Abu Dhabi, United Arab Emirates University, University of Wollongong in Dubai, and Zayed University. The UAE University has the highest link strength in this cluster, with a score of 143, indicating the most significant collaboration with other organizations in this cluster.
- Green Cluster (134 link strength, 6 organizations) includes Ajman University, Al Ain University, Canadian University in Dubai, Dubai Hospital, Dubai Medical College, and Gulf Medical University. Ajman University has the highest link strength in this cluster, with a score of 35, indicating the most significant collaboration with other organizations in this cluster.
- Blue Cluster (548 link strength, 7 organizations), including Al Jalila Children's Specialty Hospital, Dubai Health Authority, Higher Colleges of Technology, Ministry of Health & Prevention Abu Dhabi, Mohammed Bin Rashid University of Medical & Health Sciences, Ras Al Khaimah Medical & Health Science University, and University of Sharjah. The University of Sharjah has the highest link strength in this cluster, with a score of 210, indicating the most significant collaboration with other organizations in this cluster.
- Yellow Cluster (121 link strength, 4 organizations) includes Abu Dhabi University, American University in the Emirates, British University in Dubai, and Zayed University. Zayed University has the highest link strength in this cluster, with a score of 83, indicating the most significant collaboration with other organizations in this cluster.
- Lavender Cluster (151 link strength, 4 organizations) includes Rashid Hospital, Sheikh Khalife Medical City SEHA Abu Dhabi, Sheikh Shakhout Medical City Abu Dhabi, and Tawam Hospital. Sheikh Khalife Medical City SEHA Abu Dhabi has the highest link strength in this cluster, with a score of 58, indicating the most significant collaboration with other organizations in this cluster.

It is to be noted that quite a few foreign organizations have also actively collaborated with UAE organizations. The top 10 foreign organizations are listed in Table 4, along with respective UAE organizations and their collaborative linkages.

No.	Name of the Foreign Organization	TP	TC	CPP	Name of UAE organizations and their linkages with foreign organizations in bracket
1	King Saud University, Saudi Arabia	133	5842	43.92	University of Sharaj (77), Dubai Health Authority (20),UAE University (14), Rashid Hospital(12), NYU Abu Dhabi (12)
2	University of Jordan	102	2844	27.88	University of Sharaj (35), UAE University (19), Al Ain University (15), Ajman University (12), Khalifa University of S&T (10), Zayed University (6), Dubai Health Authority (6), Rashid Hospital (5)
3	Jordan University of Science & Technology	99	973	9.83	University of Sharaj (55), UAE University (28), Al Ain University (9), Higher College of Technology (9), Zayed University (6)
4	University of Oxford	70	1627	23.24	UAE University (31), University of Sharaj (25), Zayed University (12), Khalifa University of S&T (11(.,
5	Alexandria University, Egypt	60	759	12.65	UAE University (15), MBR University of Medical & Health University (11), Cleveland Clinic Abu Dhabi (8)
6	Cairo University, Egypt	58	817	14.09	University of Sharaj (27), Al Ain University (10), UAE University (7), Rashid Hospital (6), Ajman University (5), Dubai Hospital (5), Dubai Health Authority (5)
7	Amity University, India	58	412	7.10	UAE University (6)
8	Hasemite University, Turkey	54	647	11.98	University of Sharaj (29), UAE University (16), Al Ain University (13), Zayed University (6)
9	Imperial College London, U.K.	52	6095	117.21	NYU Abu Dhabi (14)
10	University of Sao Paulo, Brazil	49	4285	87.45	MBR University of Medical & Health Sciences (11), UAE University (8)

TP: Total publications; TC; Total citations; CPP: Citations per paper

Table 4. Covid-19 research: Top 10 foreign organizations in collaboration with UAE organizations.

MOST PRODUCTIVE & IMPACTFUL AUTHORS

The top 30 authors from UAE in Covid-19 research published 14 to 83 publications during the period under study. Together, these 30 authors contributed 657 papers and 11883 citations, accounting for 19.31% share of 3402 (actual UAE output) and 28.76% share of 41321 (actual number of citations to all UAE publications). Among the top 30 authors, only eight authors published more than the average publication productivity (21.9): R. Halwani (n=83), Z. Umar (n=38), Q. Hamid (n=37), B. Saddik and M.A. Naeem (n=25 each), F.A. Nawaz and K.H. Alzoubi (n=24 each) and T. Loney (n=22). In comparison, only nine authors registered citation impact in terms of CPP and RCI more than their average value (18.09 and 1.49) (Table 5).

No.	Name of the author	Affiliation of the author	TP	TC	CPP	RCI	TCL	HCP
1	R. Halwani	University of Sharjah	83	4367	52.61	4.33	118	6
2	Z. Umar	Zayed University	38	925	24.34	2.00	0	1
3	Q. Hamid	University of Sharjah	37	815	22.03	1.81	102	2
4	B. Saddik	University of Sharjah	25	568	22.72	1.87	36	2
5	M. A. Naeem	United Arab Emirates University	25	238	9.52	0.78	18	0
6	F. A. Nawaz	Mohammed Bin Rashid University of Medical & Health Sciences	24	123	5.13	0.42	0	0
7	K. H. Alzoubi	University of Sharjah	24	58	2.42	0.20	20	0
8	T. Loney	Mohammed Bin Rashid University of Medical & Health Sciences	22	414	18.82	1.55	19	1
9	P. Nasa	NMC Specialty Hospital, Dubai	21	165	7.86	0.65	0	0
10	S. A. Salloum	University of Sharjah	20	286	14.30	1.18	0	1
11	J. Mallat	Cleveland Clinic Abu Dhabi	20	164	8.20	0.67	20	0
12	N. Sahebsharif-Askari	Sharjah Institute of Medical Research, University of Sharjah	19	338	17.79	1.46	70	1
13	F. Sahebsharif-Askari	Sharjah Institute of Medical Research, University of Sharjah	19	372	19.58	1.61	64	1
14	N. A. Khan	American University of Sharjah	19	112	5.89	0.49	17	0
15	R. Siddiqui	American University of Sharjah	18	93	5.17	0.43	17	0
16	B. Mahboub	Rashid Hospital	18	150	8.33	0.69	34	0
17	S. Karim	United Arab Emirates University	18	160	8.89	0.73	18	0
18	M. J. Tabash	Al Ain University	17	44	2.59	0.21	0	0
19	M. S. Babar	Dubai Medical College	17	115	6.76	0.56	9	0
20	H. Q. Al Shamsi	University of Sharjah	17	514	30.24	2.49	0	1
21	M. S. Babar	Dubai Medical College	17	115	6.76	0.56		
22	M. I. Tabash	Al-Ain University	17	45	2.65	0.22		
23	A. Alsheikh-Ali	Mohammed Bin Rashid University of Medical & Health Sciences	16	413	25.81	2.12	23	1
24	I. Elbarazi	UAE University	16	243	15.19	1.25		1
25	A. S. Al Dhaheri	UAE University	16	461	28.81	2.37	9	1
26	W. Hafez	NMC Royal Hospital, Khaifa City	15	18	1.20	0.10		
27	R. Hamoudi	University of Sharjah	15	209	13.93	1.15	42	
28	A. A. Jairoun	Dubai Municipality	15	107	7.13	0.59		
29	S. S. M Soliman	University of Sharjah	15	127	8.47	0.70		
30	L. Cheikh Ismail	University of Sharjah	14	124	8.86	0.73		
		Total of top 30 authors	657	11883	18.09	1.49		
		UAE total publications	3402	41321	12.15	1.00		
		Share of top 20 authors in total UAE publications	19.31	28.76				

TP: Total publications; TC; Total citations; CPP: Citations per paper; ICP: International collaborative publications; RCI; Relative citations index; TLS: Total link strength; HCP: High-cited papers

Table 5. Bibliometric profile of top 30 most productive authors in COVID-19 research.

Individually, the total link strength (TLS) or collaborative linkages of 30 top authors varied from 0 to 118, with the highest collaborative links (118) depicted by R Halwani, followed by Q. Hamid (102 linkages), F. Sahebsharif-Askari (70 linkages), N. Sahebsharif-Askari (64 linkages), R. Hamoudi (42 linkages), B. Saddik (36 linkages), B. Mahboub (34 linkages), A. Alsheikh-Ali (23 linkages), etc. The top 30 authors one-to-one collaborative linkages varied from 1 to 32. The author pair "R Halwani and Q. Hamid" depicted the highest number of collaborative linkages (32), followed by "R Halwani and B. Saddik"(20 linkages), "R Halwani and F. Saheb Sharif-Askari" and "R Halwani and N. Saheb Sharif-Askari" (19 linkages each), " M.A.Naeem and S. Karim" (18 linkages), "N.A. Khan and R. Siddique"(17 linkages), "A. Alsheikh-Ali and T. Loney and "Q. Hamid and R. Harmoudi" (11 linkages each), "R Halwani and B.Mahboub" (10 linkages), etc.

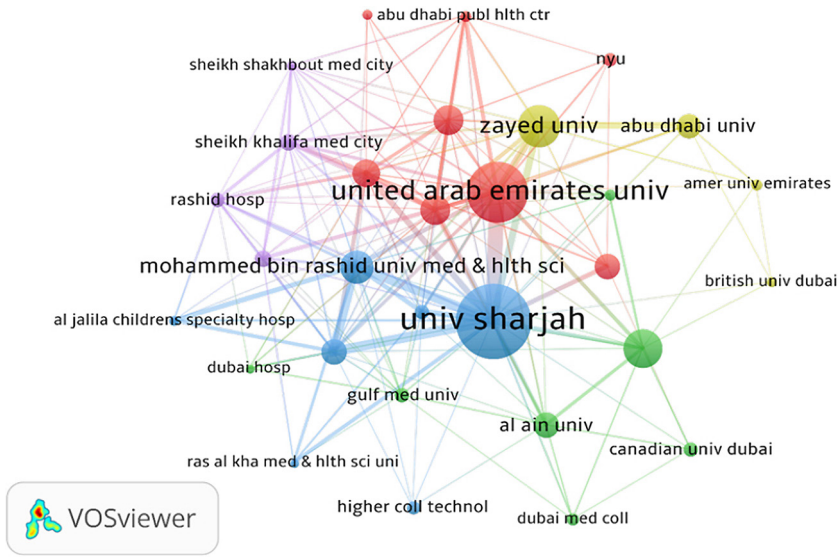

Figure 2. Co-authorship collaboration network of the top 23 authors in COVID-19 Research in UAE.

Figure 2 presents the collaborative network map of the top 23 authors in five clusters, each with a different color. The blue cluster has the highest TLS of 83, followed by the green cluster with a TLS of 408, the Red cluster with a TLS of 68, the yellow cluster with a TLS of 45, the lavender cluster with a TLS of 40, and the light blue cluster with a TLS of 34.

Several foreign authors actively collaborated with UAE authors. These top 6 foreign authors are listed in Table 6 with their collaborative linkages with respective UAE authors.

S. No.	Name of the Foreign author	Affiliation of the foreign author	TP	TC	CPP	Name of UAE organizations and their linkages with foreign organizations in bracket
1	M. H. Temsah	King Saud University, Saudi Arabia	30	806		R. Halwani (27), K. Alhaan (17), B. Siddik (17)
2	M. Y. Essar	Kabul University	27	149		F.A. Nawaz (13), S. Ahmad (11), M.S.Babar (9)
3	B. Godman	Sefako Makgatho Health Science University, Malaysia	27	157		J.C. Meyer(11), A.A. Jairoun (5)
4	S. A. Memish	Ministry of Health, Saudi Arabia	19	2228		Alhasan, K. (10), Halwani, R. (10), Alhaboob, A. (9), Saddik, B.(8)
5	S. Al Heialy	Meakins-Christie Labs, Canada				Hamid, Q.(11), Halwani, R. (10), Saheb Sharif-Askari, N. (8), Saheb Sharif-Askari, F.(6)
6	J. A. Al-Tawfiq	Johns Hopkins University School of Medicine, Baltimore, MD, United States	17	297		Alhasan, K. (16), Barry, M (16), Halwani, R. (16) Alhaboob, A.(14)

Table 6. Top 6 foreign authors in collaboration with UAE authors in Covid-19 research.

MOST PRODUCTIVE & IMPACTFUL JOURNALS

Individually, the top 30 journals published 9 to 73 papers. Together, they contributed 604 papers, constituting 19.95% share in all journal papers of UAE. Among the top 30, the six most productive journals were: *PLOS One* (n=73), *International Journal of Environmental Research & Public Health* (n=46), *Scientific Reports* (n=36), *Frontiers in Public Health* and *Vaccines* (n=35 each) and *Sustainability Switzerland* (n=31). Among the top 30, the six top 6 journals by CPP were: *International Journal of Infectious Diseases* (30.56 CPP), *IEEE Access* (20.49 CPP), *Frontiers in Psychiatry* (17.40 CPP), *Frontiers in Immunology* (13.33 CPP), *International Journal of Environmental Research & Public Health* (13.28 CPP) and *PLOS One* (12.21 CPP) (Table 7).

No.	Journal name	TP	TC	CPP
1	PLOS One	73	891	12.21
2	International Journal of Environmental Research & Public Health	46	611	13.28
3	Scientific Reports	36	375	10.42
4	Frontiers in Public Health	35	363	10.37
5	Vaccines	35	204	5.83
6	Sustainability Switzerland	31	170	5.48
7	Frontiers in Medicine	24	121	5.04
8	Heliyon	23	121	5.26
9	Healthcare Switzerland	21	86	4.10
10	IEEE Access	21	430	20.48
11	Studies in Systems Decisions & Control	21	149	7.10
12	Antibiotics	18	64	3.56
13	Information Science Letters	17	17	1.00
14	Journal of Infection & Public Health	16	66	4.13
15	New Emirates Medical Journal	16	15	0.94
16	Frontiers in Immunology	15	200	13.33
17	Frontiers in Psychiatry	15	261	17.40
18	Frontiers in Psychology	15	114	7.60
19	Indian Journal of Critical Care Medicine	14	33	2.36
20	Education & Information Technologies	12	54	4.50
21	International Journal of Molecular Sciences	12	48	4.00
22	Annals of Medicine & Surgery	11	13	1.18
23	Energy Economics	11	80	7.27
24	Frontiers in Nutrition	11	101	9.18
25	Vaccine	10	110	11.00
26	ACS Chemical Neurosciences	9	59	6.56
27	B.M.C. Medical Education	9	42	4.67
28	Frontiers in Pharmacology	9	97	10.78
29	International Journal of Infectious Diseases	9	302	33.56
30	Journal of International Women S Studies	9	4	0.44
	Total of top 30 journals	604	5201	8.61
	UAE Total output in journals	3027		0.00
	Share of top 30 journals in UAE journal output	19.95		0.00

Table 7. Top 30 most productive journals which reported Covid-19 research in UAE.

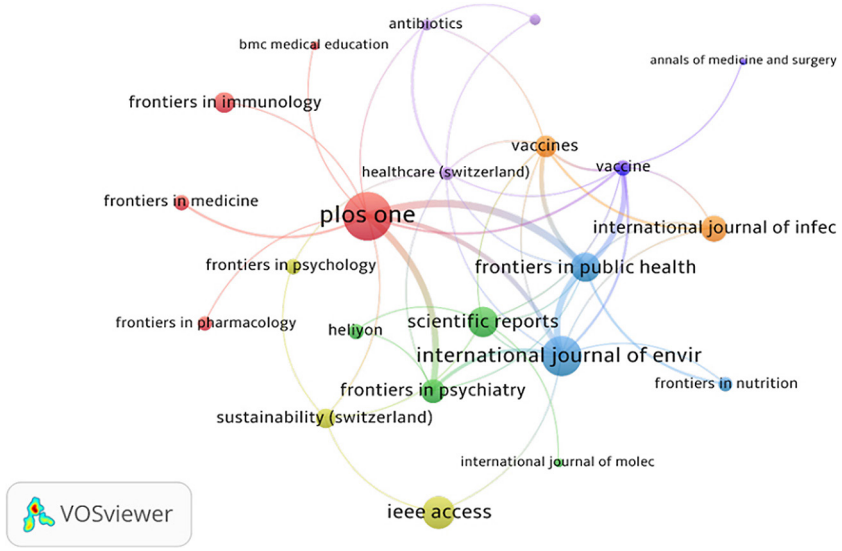

Figure 3. Co-journal network of top 30 journals which reported COVID-19 Research in UAE.

Figure 3 presents the relationship network of the top 30 journals which reported Covid-19 research in UAE. Each journal represents a node, and the links between nodes indicate the co-journal citation relationship between journals under study. Out of the top 30 journals, 22 journals co-cited each other. The top 30 most productive journals in Covid-19 research in the United Arab Emirates are grouped into seven clusters: red, green, blue, yellow, lavender, orange, and sky blue. All these 22 journals have total links=46 and TLS=81.

Cluster 1 Red includes five journals: *BMC Medical Education, Frontiers in Immunology, Frontiers in Medicine, Frontiers in Pharmacology,* and *PLOS One*. This cluster has a TLS of 31, associated with themes related to medical research, disease management, and drug development. Cluster 2 Green includes four journals: *Frontiers in Psychiatry, Heliyon, International Journal of Molecular Sciences,* and *Scientific Reports*. This cluster has a TLS of 22, and these journals are likely to publish research related to the molecular biology, biochemistry, and epidemiology of Covid-19. Cluster 3 Blue consists of three journals: *Frontiers in Nutrition, Public Health,* and the *International Journal of Environmental Research and Public Health*. These journals are likely to publish research related to the intersection of Covid-19 and public health, nutrition, and environmental factors. Cluster 4 Lavender includes three journals: *Antibiotics, Healthcare* (Switzerland), and *Journal of Infection and Public Health*. This cluster has 16 links, with *Healthcare* (Switzerland) having the highest number of links (9). Cluster 4 Yellow includes three journals: *Frontiers in Psychology, IEEE Access,* and *Sustainability* (Switzerland). This cluster has 8 TLS, with Sustainability (Switzerland) having the highest number of links (4). Finally, the sky blue and orange clusters have two journals, respectively. The total link strength of the sky-blue cluster is 16, with the vaccine having the highest total publications of 10. The total link strength of the orange cluster is 17, with vaccines having the highest total publications of 36.

KEYWORDS CO-OCCURRENCE ANALYSIS

To gain insights into the research being conducted in the UAE on this topic, a co-occurrence network of 47 selected keywords was analyzed using the VOSviewer software. These keywords were chosen based on their relevance to Covid-19 research in the UAE, and their occurrence and link strength were recorded. The keywords were also clustered based on their co-occurrence patterns. In total, 13877 occurrences were found in all 3402 publications, and 160 keywords occurred 50 or more times among them. The VOSviewer software grouped the keywords into four clusters based on their link strength (8153), total links (882), and co-occurrence patterns: red, green, blue, and yellow, as seen in Table 8 and Figure 4.

The red cluster, focused on clinical aspects of COVID-19, has total link strength of 2013. The keywords with the highest connectivity in this cluster are intensive care unit and hospitalization, linked to other keywords such as comorbidity, diabetes mellitus, and adult respiratory distress syndrome. This suggests that the research in this cluster is primarily aimed at understanding the clinical management of COVID-19, particularly for patients with comorbidities. The green cluster, which is the second-largest, has total link strength of 837. This cluster primarily focuses on mental health and education, with keywords such as anxiety, depression, e-learning, and social media being closely interconnected. This suggests that the psychological impact of the pandemic and the need for innovative educational strategies are important considerations in the UAE's COVID-19 research.

The largest blue cluster has the highest total link strength of 1331, indicating a strong association between the keywords within this cluster. The keywords with the highest connectivity in this cluster are COVID-19 and virology, linked to other keywords such as virus transmission and antivirus agents. This suggests that research in this cluster is focused on understanding the virus and its transmission dynamics and potential treatments. The yellow cluster, the smallest of the four, has a total link strength of 1070. This cluster primarily focuses on vaccination and prevention/control measures, with keywords such as COVID-19 vaccines, prevention and control, and vaccination being closely interconnected. This suggests that the research in this cluster is aimed at public health strategies to control the spread of the virus through vaccination and prevention measures.

The co-occurrence network of selected keywords in COVID-19 research in the UAE publications provides a valuable snapshot of the research priorities in the country. It highlights the diverse nature of COVID-19 research, ranging from biomedical research to mental health and education to clinical aspects of the disease. It emphasizes the importance of a comprehensive, multi-disciplinary approach to combating the pandemic.

No.	Keyword	Occ.	TLS	Cluster	S.No.	Keyword	Occ.	TLS	Cluster
1	Covid-19	1265	2250	Green	25	Mental Health	74	182	Green
2	Vaccination	187	578	Yellow	26	Anxiety	73	231	Green
3	Prevention And Control	150	503	Yellow	27	Headache	73	406	Red
4	Virus Pneumonia	138	353	Blue	28	Disease Transmission	72	231	Blue
5	Intensive Care Unit (ICU)	123	563	Red	29	Lockdown	71	176	Green
6	Hospitalization	119	485	Red	30	D Dimer	70	374	Red
7	Virology	110	396	Blue	31	Angiotensin Converting Enzyme 2	69	218	Blue
8	Social Media	106	250	Green	32	Immunology	69	265	Blue
9	Diagnosis	104	255	Green	33	Immune Response	68	231	Blue
10	Covid-19 Vaccines	104	404	Yellow	34	Adult Respiratory Distress Syndrome	67	319	Red
11	Comorbidity	101	427	Red	35	Fatigue	64	330	Red
12	Dyspnea	98	536	Red	36	Tocilizumab	64	351	Red
13	Virus Transmission	97	296	Blue	37	Drug Therapy	63	226	Blue
14	Psychology	95	262	Green	38	Education	63	120	Green
15	Genetics	93	273	Blue	39	Favipiravir	61	347	Red
16	Diabetes Mellitus	92	437	Red	40	Ferritin	61	329	Red
17	C Reactive Protein	91	472	Red	41	Pneumonia	61	282	Red
18	Hydroxychloroquine	88	454	Red	42	Depression	57	183	Green
19	Deep Learning	84	125	Green	43	Machine Learning	57	123	Green
20	Artificial Ventilation	84	392	Red	44	Vaccine	54	233	Yellow
21	Hypertension	83	467	Red	45	Forecasting	53	86	Green
22	Antivirus Agent	81	288	Blue	46	Obesity	53	215	Red
23	E-Learning	77	78	Green	47	Artificial Intelligence	52	120	Green
24	Infection Control	76	184	Blue					

Table 8. Co-occurrence network of keywords in Covid-19 research in the UAE publications.

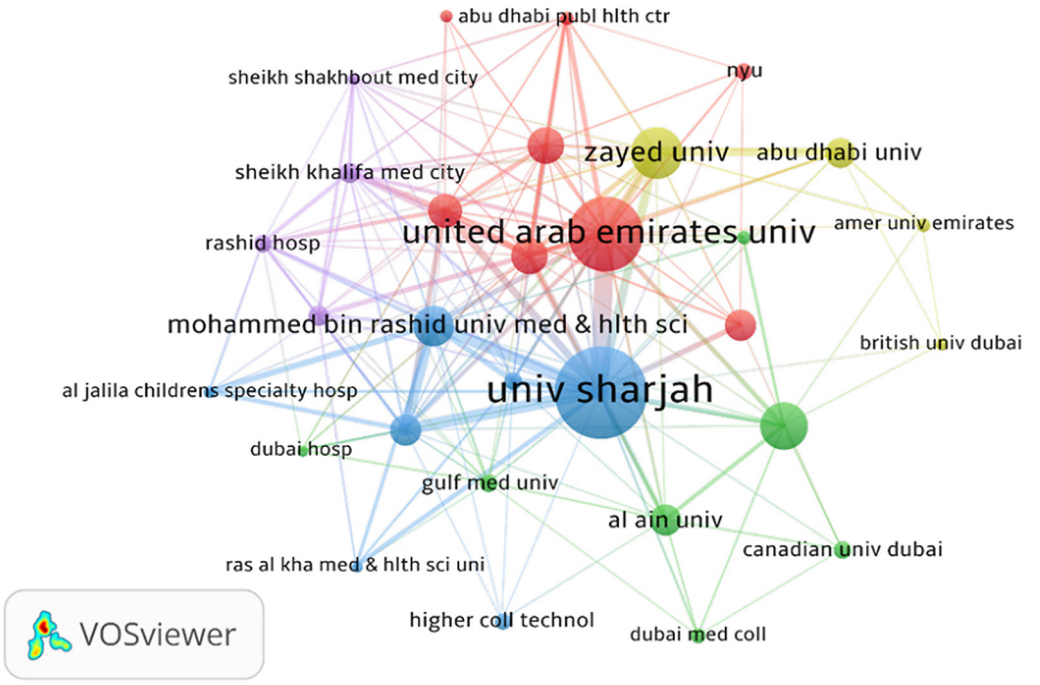

Figure 4. Co-occurrence network of 47 selected keywords.

HIGH-CITED PAPERS

All such UAE publications on Covid-19 that have received 50 or more citations since their publication are defined as high-cited papers (HCPs). In all, 147 (4.32%) out of 3402 publications on Covid-19 by UAE confirmed this definition of high-cited papers. The citations these papers received per paper since publication ranged from 50 to 1361, averaging 147.66 (CPP). Citation-wise, the distribution of 147 HCPs is as follows. Ninety papers received 50-99 citations per paper, 135 papers (100-200 citations), 11 papers (203-297 citations0, seven papers (303-519 citations), and four papers (1093-1361 citations). Their distribution by publication type was that 107 appeared as articles, 31 reviews, four notes, two editorials, one each as a conference paper and letter. Of the 147 HCPs, 73 appeared in 2020, 66 in 2021, seven in 2022 and one in 2023.

Of the 147 HCPs, only 55 (37.41%) appeared as output from projects funded by external national and international agencies, and these 55 HCPs received 9354 citations since their publication, averaging 170.07 CPP. The major funding agencies supporting UAE high-cited research were UAE University (11 papers), National Institute of Health (10 papers), University of Sharjah and King Saud University, Saudi Arabia (4 papers each), Khalifa University of Science, Technology & Research (3 papers), etc. Of the 147 HCPs, 130 (88.43%) were international collaborative papers (ICPs), received 20278 citations, and averaged 155.98 CPP. Out of 130 ICPs, the USA contributed 54 papers, followed by U.K. (49 papers), Canada (35 papers), Saudi Arabia and Australia (30 papers each), India and Jordan (27 papers each), Egypt (25 papers), Pakistan (14 papers), etc. Their distribution by Scopus subject categories showed that most HCPs were in Medicine (75 papers), followed by Biochemistry, Genetics & Molecular Biology (19 papers), Social Sciences (18 papers), Computer Science (15 papers), Engineering and Environmental Science (11 papers each), Economics, Econometrics & Finance (8 papers), Immunology & Microbiology and Psychology (7 papers each), etc.

THE 147 HCPs distribution among national organizations showed that University of Sharjah contributed the most papers (38), followed by United Arab Emirates University (34 papers), Zayed University (16 papers), Mohammed Bin Rashid University of Medical & Health Sciences (15 papers), Cleveland Clinic Abu Dhabi (10 papers), NYU Abu Dhabi (8 papers), Khalifa University of Science & Technology (7 papers),

Dubai Health Authority (6 papers), Al Ain University Al Jalila Children's Specialty Hospital and Canadian University in Dubai (5 papers each), Ajman University and American University in Emirates (3 papers each), Abu Dhabi University, American University of Sharjah, Gulf Medical University and Tawam Hospital (2 papers each), etc.

Top authors of 147 HCPs are R. Halwani (10 papers), followed by Z. Omar (5 papers), A. S. Al Dhaheri and Q. Hamid (4 papers each), B. Saddik (3 papers), S. Al Heialy, A. Alsheikh-Ali (2 papers each), etc. Most 147 HCPs were published in *JMIR Public Health & Surveillance* and *PLOS One* (3 each), followed by *Biology of Sports, Critical Care Medicine, Intensive Care Medicine, Finance Research Letters, International Journal of Environmental Research & Public Health, Journal of Health Psychology, Maturitas, Nature, Nutrients, Science and Science Immunology* (2 papers each) and other journals published one paper each.

FINAL CONSIDERATIONS

The present study utilized a bibliometric approach to undertake a quantitative and qualitative analysis of the UAE publications (3402) on Covid-19 research that the UAE had published from December 2019 to April 2023. The bibliographic data was analyzed on a series of parameters such as publication type output, publication language-wise output, output by national and international funding agencies, output based on national and international collaboration, institutional production at the national level, research output at the author level, and subject-wise output. For qualitative analysis, the publication data was analyzed on parameters such as citations per paper and relative citation index measured at institutional and individual author levels. Further, this data was also utilized to highlight and analyze high-cited papers by the UAE during the period under study. The study has also attempted to provide visual graphics to highlight collaboration network trends of the top 30 organizations, authors, and journals that reported UAE publications in Covid-19 research.

This study captured COVID-19 research in the UAE from the Scopus database. This data was analyzed on several parameters to understand the ongoing research trends in the subject. The world share of the USA in Covid-19 research during the period under study was 24%, the UK 9.78%, China 8.99%, and India 7.33%. In contrast, the world share of the UAE was less than 1% (0.71%, to be exact). Given this performance, the UAE is still a minor player in global Covid-19 research. The top 30 research institutions in the UAE in the subject differ widely in the quality and quantity of their research. For instance, the American University in the Emirates, which topped the tally on the parameter of citations per paper (40.5 CPP), ranked at 20th place on the publication productivity parameter (39 papers). The University of Sharjah ranked top regarding institutional productivity (619 papers) and ranked 5th on citations per paper (17.2 CPP). The UAE should seek to bridge this gap to the extent possible. The UAE had significant collaboration at the inter-institutional level in Covid-19 research within the country and across countries of North America & Europe, the Middle East, and South Asia. Most Covid-19 research in the UAE has resulted from funding from national and international agencies. This is a very positive development. The UAE and other Arab world countries need to strengthen their collaboration mechanism with developed world countries before they can aspire to emerge as significant leaders in Covid-19 research.

Contribution statement

Conceptualization: B. M. Gupta.

Data curation, visualization: Mallikarjun Kappi.

Investigation, methodology, writing- original draft and project administration: B. M. Gupta.

Writing and editing the manuscript: B. M. Gupta and S.M. Dhawan.

Conflict of interest

The authors declare that there is no conflict of interest.

Statement of data consent

The data generated during the development of this study has been included in the manuscript.

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