



Estimating the Online Presence of COVID-19 Papers in Social Media: An Altmetric Study

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Abstract

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Introduction: As the significant pandemic of the millennium, COVID-19 attracted research interest worldwide, and many papers have been published on the topic and increasingly shared in different social media. This study aimed to estimate the presence of COVID-19 papers in social media.

Methods: In this altmetric survey, Altmetric Explorer was used for data extraction. A comprehensive unlimited search was done on 9 July 2022 for COVID-19 papers mentioned at least once on social media. All 162,068 related papers as the study population was analyzed in Excel 2016 and SPSS v22.

Results: 151,956 COVID-19 papers (93.76%) were mentioned at least once on social media. Most papers (100,295) were within the altmetric attention score ranging from 1-10. As the top-ranked source, Twitter mentioned 144,073 papers (88.90%), followed by Mendeley, covering 129,328 (79.79%), papers and News Outlet covering 39,445 papers (24.33%). Most Twitter, Facebook, and News users were from the USA and the UK. "MedRexiv" ranked first with mentioning 10,971 papers, followed by the British Medical Journal with 2,122 mentioned papers and the Lancet with 692 mentioned papers. In the top highly-mentioned papers, some central aspects of the disease, such as its prevention, treatment, and vaccination, were considered as main public concerns.

Conclusion: COVID-19 research has been increasingly presented in social media, which is a sign of considering COVID-19 as a primary human concern. Thus, social media platforms have a prominent role in the reach and visibility of research output in COVID-19.

Introduction

As an infectious disease, COVID-19 is a central public health concern worldwide (1, 2). COVID-19 was first identified in Wuhan, Hubei province, China, in December 2019 (3). The virus

causes, among others, severe respiratory problems (4) that are similar to acute respiratory syndrome (5). As a novel beta-coronavirus, it is the third known zoonotic coronavirus following MERS and



SARS (6). The virus is spreading rapidly worldwide and has infected many countries worldwide. On January 30, 2020, the World Health Organization (WHO) declared the spread of COVID-19 a severe health risk to the world (7).

Attention to and mention of published COVID-19 scientific papers on online social media started in January 2020 (8). The challenging and global expansion of COVID-19 has led to the publication of a significant number of papers on the disease (9). Therefore, measuring and estimating people's attention and reaction to COVID-19 papers in online social media is necessary (2).

Traditionally, the citation rate was the leading measuring indicator of attention to a paper (10-13). However, some researchers noted the citation rate's serious weaknesses (13-19). New technologies and web 2.0 tools have impressed researchers' scientific communications (20). Today, researchers share their scientific papers via online social media and Web 2.0 tools to increase their visibility and reach (15). The widespread use of online social media by researchers led to create of new metrics, alternative metrics, or altmetrics, to assess the scientific and social impact of the scientific output (21). This metric takes some public indicators other than traditional citation-based ones into account (22).

After COVID-19 identification, the disease has been at the top of the world's news. Many papers on COVID-19 have been published and shared via online social media. The bibliometric analysis could not measure the scientific and social impact of COVID-19 scientific output in this short time; therefore, it is necessary to use the altmetric analysis. Altmetric indicators can measure papers' scientific and social impact in an instant shorter time (21). These indicators can evaluate people's attention and reaction to COVID-19 papers on online social media. Covid-19 research has not been widely investigated and traced back to social media applications and platforms. Hence, to identify the gap, we designed a study to identify published papers on COVID-19 with the most online attention scores in the social media in which these papers have been shared and to measure their scientific and social impact.

Materials and Methods

This study is applied research that was done by the altmetric method. As a known altmetric tool and updated and appropriate depiction of online activity and discussion forum for research output, Altmetric Explorer (Altmetric LLP, London, UK) was used for data collection. It extracts mentions of

research papers from different online resources (such as public policy documents, post-publication peer-review platforms, Wikipedia, Open Syllabus Project, Patents, Blogs, mainstream media from over 2,000 outlets, online reference managers such as Mendeley and CiteULike, peer-review platforms, including Publons and Pubpeer, academic and non-academic blogs, social media networks and multimedia and other online platforms such as YouTube and Reddit as well as MedRexiv). It assigns an individual weighted score for each mentioned source, named Altmetric Attention Score (AAS). The score ranges from .25 to 8.0. The highest score is assigned to news agencies, and blogs and the lowest score is for Facebook, Q&A, YouTube, Pinterest, and Reddit. Altmetric Explorer traces many thousand scientific papers and presents some altmetric indicators of a paper (21).

On 9 July 2022, a comprehensive search was conducted in Altmetric Explorer for papers published on COVID-19. No limitation was made in the search strategy. One hundred sixty-two thousand sixty-eight research papers on COVID-19 were extracted from Altmetric Explorer and analyzed as the research population. The search strategy was as follows:

TITLE-ABS-KEY("nCoV" OR "COVID 19" OR "COVID-19 Virus Disease" OR "COVID-19" OR "COVID 19 Virus Disease" OR "COVID-19 Virus Diseases" OR "Disease, COVID-19 Virus" OR "Virus Disease, COVID-19" OR "COVID-19 Virus Infection" OR "COVID 19 Virus Infection" OR "COVID-19 Virus Infections" OR "Infection, COVID-19 Virus" OR "Virus Infection, COVID-19" OR "2019-nCoV Infection" OR "2019 nCoV Infection" OR "2019-nCoV Infections" OR "Infection, 2019-nCoV" OR "Coronavirus Disease-19" OR "Coronavirus Disease 19" OR "2019 Novel Coronavirus Disease" OR "2019 Novel Coronavirus Infection" OR "2019-nCoV Disease" OR "2019 nCoV Disease" OR "2019-nCoV Diseases" OR "Disease, 2019-nCoV" OR "COVID19" OR "Coronavirus" OR "Coronavirus Disease 2019" OR "Disease 2019, Coronavirus" OR "SARS Coronavirus 2 Infection" OR "SARS-CoV-2 Infection" OR "Infection, SARS-CoV-2" OR "SARS CoV 2Infection" OR "SARS-CoV-2 Infections" OR "COVID-19 Pandemic" OR "COVID 19 Pandemic" OR "COVID-19 Pandemics" OR "Pandemic, COVID-19")

For extracting some bibliometric data (citation counts) from the paper, this study used Web of Science (WoS), Scopus, Google Scholar, and Dimensions. Excel 2016 spreadsheet and SPSS v22 software were used for data analysis in descriptive statistics (frequencies, percentages, means, and ranks).



Results

Presence in social media

Out of 162,068 research papers on COVID-19, 151,956 (93.76%) papers were mentioned at least once on social media and had an AAS. Ten thousand one hundred twelve papers (6.23%) were not mentioned

in social media and had no AAS. Figure 1 depicts the frequency distribution of the papers based on their AAS ranges. Most papers (100,295) were within the AAS range of 1-10. Only 13,311 papers were mentioned 100 times or more.

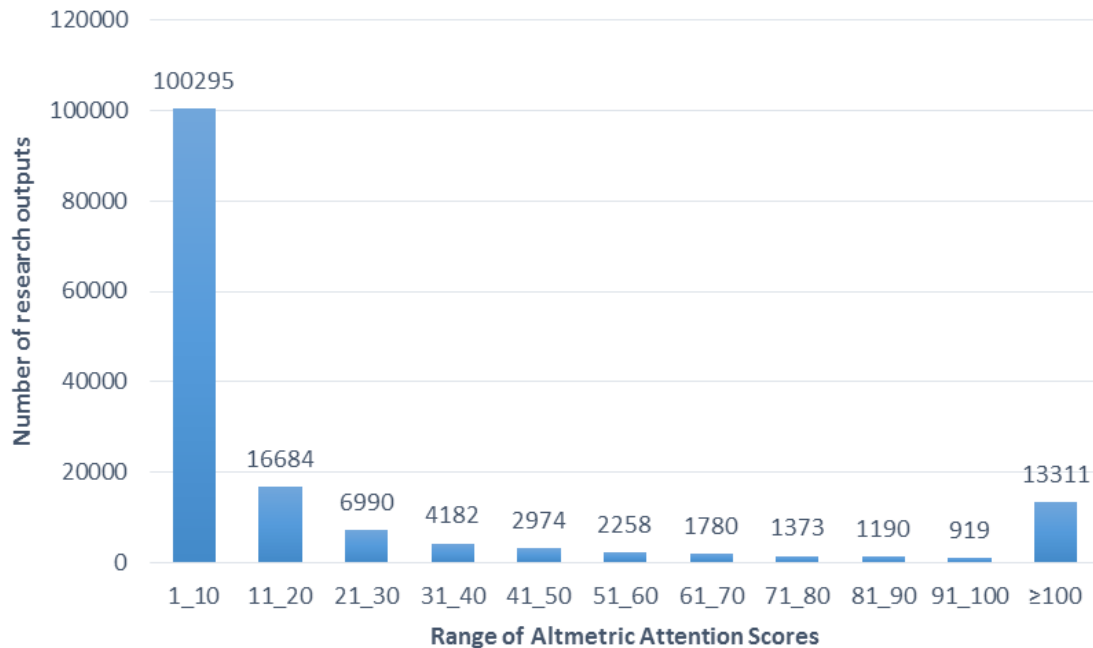


Figure 1. Frequency distribution of COVID-19 papers based on their AASs

Table 1 shows some statistics for online mentions of COVID-19 papers on different social media. As the top-ranked source, Twitter mentioned 144,073 papers (88.90%) by sharing them 13,310,326 times. The mean rate of tweets per paper was 92.38. The highest number of tweets (N=165,708) belonged to the paper entitled “Covid-19: Researcher blows the whistle on data integrity issues in Pfizer’s vaccine trial” (published by Paul D. Thacker in the British Medical Journal in 2021).

The second rank belonged to Mendeley, covering 129,328 (79.79%) papers that were read 9,427,170 times. The mean rate of readership per paper was 72.89. The highest score (17,912) belonged to the

paper entitled “The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak” (published by Hussin A Rothan and Siddappa N Byrareddy in the Journal of Autoimmunity in 2020).

The third rank belonged to the news, with 39,445 papers (24.33%) distributed 599,881 times in different news outlets. The mean rate of news per paper was 15.20. The highest score (3,117) belonged to the paper under the title “Mental health, substance use, and suicidal ideation during the COVID-19 pandemic - United States, June 24–30, 2020” (published by Mark É Czeisler et al. in MMWR: Morbidity & Mortality Weekly Report in 2020).

Table 1. Descriptive statistics for online mentions of COVID-19 papers (N= 162,068) in online social media

Source	NP* (%)	Mean per paper	Min*	Max*	Total	Rank
Twitter	144073(88.90)	92.38	0	165708	13310326	1
Mendeley	129328(79.79)	72.89	0	17912	9427170	2
News	39445(24.33)	15.20	0	3117	599881	3
Blog	20144(12.42)	2.58	0	205	52101	4
Facebook	18444(11.38)	2.21	0	188	40854	5
Policy	7751(4.78)	2.29	0	63	17774	6
Reddit	5876(3.62)	2.46	0	111	14486	7
Wikipedia	4156(2.56)	1.98	0	37	8270	8

Table 1. Descriptive statistics ... (continud)

Source	NP* (%)	Mean per paper	Min*	Max*	Total	Rank
Video	2942(1.81)	1.74	0	67	5124	9
Peer review	1171(.72)	1.26	0	9	1486	10
Patent	1054(.65)	1.69	0	31	1787	11
F1000	482(.29)	1.16	0	7	561	12
Q&A	162(.09)	1.10	0	3	179	13
Weibo	0	0	0	0	0	14
Google+	0	0	0	0	0	14
LinkedIn	0	0	0	0	0	14
Pinterest	0	0	0	0	0	14
Syllabi	0	0	0	0	0	14

*NP: Number of Papers; Min: Minimum; Max: Maximum

Users' countries of origin

Table 2 shows the top 20 countries having users on Twitter, Facebook, News, and Policy based on total mentions of COVID-19 papers.

On Twitter, users from 235 countries worldwide tweeted COVID-19 papers 13,310,326 times by 2,589,153 unique tweeters. The first rank belonged to the USA with 1,799,223 posts, followed by the UK with 819,135 posts and Japan with 362,106 posts. In this regard, 6,919,954 tweets were unknown.

On Facebook, users from 91 countries posted COVID-19 papers 40,854 times on 5,035 unique Facebook pages. The first to third ranks belonged to the USA with 7,859 posts, the UK with 1,612 posts,

and Turkey with 1,391 posts, respectively. In this regard, 23,163 posts were unknown.

Regarding the news, users from 142 countries distributed COVID-19 papers 599,881 times with 3,669 unique news stories. The first to third ranks belonged to the USA with 372,807 news stories, the UK with 53,176 news stories, and Australia with 40,780 news stories, respectively. In this regard, 678 news outlets were unknown.

In Policy documents and sources, 17,774 documents were distributed by 111 unique policy sources from 36 countries. Switzerland ranked first with 8,754 documents, followed by the USA with 2,279 documents and Italy with 1,636 documents.

Table 2. Distribution of top 20 countries in using Twitter, Facebook, News and Policy Sources based on the number of posts

Tweets and tweeters				Facebook posts and Pages				News stories and outlets				Policy documents and sources			
Rank	Country name	Number of posts	Number of profiles	Rank	Country name	Number of posts	Number of profiles	Rank	Country name	Number of posts	Number of profiles	Rank	Country name	Number of posts	Number of profiles
1	United States	1779223	340010	1	United States	7859	947	1	United States	372807	1305	1	Switzerland	8754	7
2	United Kingdom	819135	133129	2	United Kingdom	1612	166	2	United Kingdom	53176	390	2	United States	2279	25
3	Japan	362106	62917	3	Turkey	1391	6	3	Australia	40780	175	3	Italy	1636	3
4	Canada	344853	54397	4	Canada	821	85	4	India	34206	185	4	United Kingdom	1581	13
5	Spain	316222	55294	5	Italy	791	46	5	New Zealand	10448	21	5	Luxembourg	976	1
6	France	315394	42033	6	Ecuador	476	5	6	Canada	9999	89	6	Germany	485	1
7	Brazil	222409	57912	7	Brazil	460	50	7	Germany	8850	134	7	Australia	447	5
8	Australia	198849	26821	8	Paraguay	343	1	8	Spain	7019	98	8	Netherlands	415	5
9	Germany	174191	29044	9	Spain	327	44	9	France	6351	86	9	Sweden	327	3
10	Mexico	165288	40108	10	Costa Rica	257	4	10	Brazil	4696	114	10	France	316	2
11	India	131325	42062	11	Australia	254	91	11	Italy	3456	64	11	Ethiopia	168	3
12	Italy	97563	15680	12	Germany	216	30	12	Switzerland	3230	30	12	Norway	69	2
13	Netherlands	94178	14131	13	Belgium	215	15	13	Russia	2868	27	13	Belgium	57	2
14	Argentina	74274	17894	14	Mexico	210	43	14	South Africa	2458	38	14	Kenya	55	4
15	Ireland	67477	10957	15	Austria	209	12	15	Singapore	2289	16	15	South Africa	48	7
16	Chile	61100	15078	16	Thailand	200	10	16	Netherlands	2049	53	16	Canada	30	3
17	Switzerland	58970	7028	17	Slovakia	171	3	17	Turkey	1915	22	17	Brazil	19	1
18	Colombia	54993	13106	18	France	154	12	18	Argentina	1803	12	18	Morocco	19	1
19	Thailand	54154	20148	19	Argentina	139	9	19	Bangladesh	1796	17	19	Panama	16	1
20	Turkey	53289	15573	20	Philippines	124	8	20	Japan	1747	55	20	Philippines	12	1



Top highly-mentioned publishing institutes

Regarding the top three publishing institutes with high total mention rates, the University of Oxford ranked first with 1,856 papers that were mentioned

924,413 times. The second rank belonged to Harvard University, with 3,162 papers mentioned 827,552 times. The third-ranked institute was Imperial College London, with 1,478 papers mentioned 457,185 times.

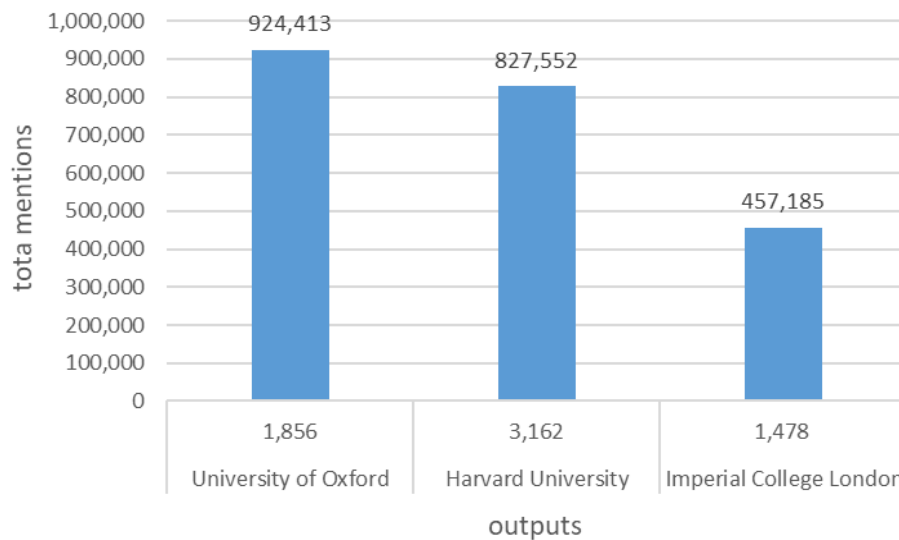


Figure 2. Top three highly-mentioned research institutions publishing on Covid-19

Top highly-mentioned publishing journals

In total, 8,253 journals published papers on COVID-19. Table 3 shows some bibliometric features of the top ten highly-mentioned journals publishing papers on COVID-19. MedRxiv, as an internet medical-related website, ranked first with mentioning 10,971 papers, in a total of 1,577,383

mentions. The second and third ranks belonged to the British Medical Journal, with 2,122 mentioned papers in 1,111,499 mentions, and the Lancet (also the highest-ranked journal) with 692 mentioned papers in 916,128 mentions, respectively. The majority of these journals were Q1. Nine journals were from the USA or the UK.

Table 3. Characteristics of the top ten highly-mentioned journals publishing on Covid-19

Rank	Journal title	Mentioned papers	Total mentions	SJR	SJR quartile
1	medRxiv*	10971	1577383	-	-
2	British Medical Journal	2122	1111499	1.831	Q1
3	The Lancet	692	916128	13.103	Q1
4	New England Journal of Medicine	379	796095	19.889	Q1
5	MMWR: Morbidity & Mortality Weekly Report	295	596686	7.992	Q1
6	JAMA: Journal of the American Medical Association	550	559590	4.688	Q1
7	The Conversation*	3336	353404	-	-
8	Nature	210	255430	15.993	Q1
9	Science	223	248266	12.556	Q1
10	Nature Medicine	198	205474	19.536	Q1

*An Internet site and preprint platform; SJR: SCImago Journal Rank

Top highly-mentioned papers and their citation performance

Table 4 shows the top ten highly-mentioned papers based on their AASs and their citation counts. The











highest AAS (=46,060) belonged to a paper entitled “Covid-19: Researcher blows the whistle on data integrity issues in Pfizer’s vaccine trial” (published by Paul D. Thacker in the British Medical Journal



in November 2021. The citation counts of the paper in WoS, Scopus, Google Scholar, and Dimensions were 5, 4, 20, and 5, respectively. Andrew Bryant et al.'s paper entitled "Ivermectin for prevention and treatment of COVID-19 infection: A systematic review, meta-analysis, and sequential trial analysis to inform clinical guidelines" (published in the American Journal of Therapeutics in July 2021, ranked second with ASS=31,182. It received 37, 30, 99, and

62 citations in WoS, Scopus, Google Scholar, and Dimensions, respectively. The third-ranked paper with AAS=28,180 entitled "Safety and efficacy of an rAd26 and rAd5 vector-based heterologous prime-boost COVID-19 vaccine: an interim analysis of a randomized controlled phase 3 trial in Russia". Nine papers were original articles and highly-cited. Five papers were published in the Lancet, and most of these top papers were multi-authored.

Table 4. Top ten highly-mentioned papers on COVID-19 and their citation counts

Rank	Article title (Year)	First author	Journal title	Paper type	AAS*	WoS	Scopus citation	Google Scholar citation	Dimensions citations
1	Covid-19: Researcher blows the whistle on data integrity issues in Pfizer's vaccine trial (November 2021)	Paul D Thacker	British Medical Journal	Article		5	4	20	5
2	Ivermectin for Prevention and Treatment of COVID-19 Infection: A Systematic Review, Meta-analysis, and Trial Sequential Analysis to Inform Clinical Guidelines (July 2021)	Andrew Bryant	American journal of therapeutics	Article		37	30	99	62
3	Safety and efficacy of an rAd26 and rAd5 vector-based heterologous prime-boost COVID-19 vaccine: an interim analysis of a randomised controlled phase 3 trial in Russia (February 2021)	Denis Y Logunov	The Lancet	Article		466	513	953	691
4	COVID-19: Stigmatizing the unvaccinated is not justified (November 2021)	Günter Kampf	The Lancet	Article		0	0	3	2
5	Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine (December 2020)	Fernando P	New England Journal of Medicine	Article		3348	3566	6429	5300
6	Increases in COVID-19 are unrelated to levels of vaccination across 68 countries and 2947 counties in the United States (September 2021)	S. V. Subramanian	European Journal of Epidemiology	Article		8	10	47	19
7	The epidemiological relevance of the COVID-19-vaccinated population is increasing (December 2021)	Günter Kampf	The Lancet Regional Health - Europe	Article		0	0	5	2
8	Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis (June 2020)	Derek K Chu	The Lancet	Article		1262	1475	2663	2000
9	Study to Describe the Safety, Tolerability, Immunogenicity, and Potential Efficacy of RNA Vaccine Candidates Against COVID-19 in Healthy Adults (April 2020)		ClinicalTrials.gov	Clinical trial		NA	NA	2	0
10	RETRACTED: Hydroxychloroquine or chloroquine with or without a macrolide for treatment of COVID-19: a multinational registry analysis (May 2020)	Mandeep R Mehra	The Lancet	Article		663	474	1366	674

*AAS: Altmetric Attention Score



The leading altmetric indicators of the top ten highly-mentioned papers are shown in Table 5. The first-ranked paper in AAS, entitled “Covid-19: Researcher blows the whistle on data integrity issues in Pfizer’s vaccine trial,” were shared 165708 times by Twitter, 167 times by News outlets, 21 times by Facebook, six times by Wikipedia, 111 times by Reddit, 26 times by Video and 120 times by Mendeley.

Table 5. Altmetrics indicators of the top ten high-mentioned papers on COVID-19

Rank	Article title	TC	NC	BC	FBC	WC	RC	VC	MC
1	Covid-19: Researcher blows the whistle on data integrity issues in Pfizer’s vaccine trial	165708	167	16	21	6	111	26	120
2	Ivermectin for Prevention and Treatment of COVID-19 Infection: A Systematic Review, Meta-analysis, and Trial Sequential Analysis to Inform Clinical Guidelines	89387	159	26	15	1	36	11	238
3	Safety and efficacy of an rAd26 and rAd5 vector-based heterologous prime-boost COVID-19 vaccine: an interim analysis of a randomised controlled phase 3 trial in Russia	55236	1010	72	34	25	12	20	1599
4	COVID-19: stigmatising the unvaccinated is not justified	65058	24	8	15	4	37	4	39
5	Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine	38503	2350	138	78	37	11	67	7479
6	Increases in COVID-19 are unrelated to levels of vaccination across 68 countries and 2947 counties in the United States	75628	63	18	18	0	3	12	160
7	The epidemiological relevance of the COVID-19-vaccinated population is increasing	68613	17	11	8	0	29	12	70
8	Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis	37604	1969	126	88	7	16	16	4135
9	Study to Describe the Safety, Tolerability, Immunogenicity, and Potential Efficacy of RNA Vaccine Candidates Against COVID-19 in Healthy Adults	45898	546	26	14	19	0	9	0
10	RETRACTED: Hydroxychloroquine or chloroquine with or without a macrolide for treatment of COVID-19: a multinational registry analysis	37008	1667	178	77	28	33	15	1788

TC: twitter count; NC: news count; BC: blog count; FBC: Facebook count; WC: Wikipedia count; RC: Reddit count; VC: Video count; MC: Mendeley count



Discussion

This altmetric study aims to comprehensively investigate the online presence of COVID-19 research in social media and applications. As some previous studies considered the topic, they only focused on the exceptional time span, individual social medium, specific journal, or unique altmetric aspect and its relationship with citation counts.

The present study found that most published papers on COVID-19 were considered in social media tools and applications. Similar to this finding, it was found in a study conducted in December 2019-March 2020 that the attention to COVID-19 papers increased in Dimensions during the four months of the study (23). Concludingly, topics manifesting public concerns and health-related issues, such as the COVID-19, are heavily considered in social media, and researchers can use this opportunity to make their related research more visible and influential. As the public widely uses social media and platforms for fulfilling their information needs, manifesting health-related concerns in these media will be helpful for research and development in health.

As Twitter, Facebook, and News Outlet were the top highly-active tools in mentioning COVID-19 papers, it can be concluded that these tools are used more for sharing research data and appropriate contexts for distributing research output. Similar to our study, some previous related studies confirmed this finding and noted that online social media increased the attention to COVID-19 papers in the scientific community (24, 25). It can be concluded that Covid-19 researchers can share their contributions on online social media to make them more visible and applicable.

Many countries used these applications for sharing and mentioning papers on COVID-19. However, the share of African-Asian countries was low, and USA and the UK were the top countries. These two countries were among the top ones in another similar study (26). This is the case when considering top active research institutions and universities. However, in a short time span (December 2019-March 2020), China and Japan were active countries (23). To better depict the research on COVID-19 and to know its possible regional aspects, a worldwide contribution must be made and presented on social media.

The top highly-mentioned publishing journals on COVID-19 (such as the Lancet) were known journals

and highly-influential ones in the medical field. In a previous study, a similar finding was reported (23). Indicatively, highly-prestigious medical journals have been active on online social media tools and are more considered by the public during the pandemic.

In the top highly-mentioned papers, some main aspects of the disease, such as its prevention, treatment, and vaccination, were considered as main public concerns. These findings accord to another study (23). This reflects that treatment approaches and prevention modes are significant from the healthcare viewpoint. The correlation between these papers' altmetric performance and citation performance needs to be investigated as further research. This notification is valid in case of mentioning sources of the papers. Seemingly, using altmetrics to evaluate the research output is more necessary in issues that affect the world, such as COVID-19 (27).

Notably, the current study used only one of the altmetrics data service providers (i.e., the altmetrics database). This is a natural limitation of this study as an altmetric analysis. Other altmetric analyzing tools can be applied in further research.

Conclusion

Covid-19 research has been increasingly presented in social media, which is a sign of considering COVID-19 as a primary human concern. The study's main practical contribution and implication are that it informs scholars on the role of social media platforms and applications in the spread, reach, and visibility of research output in COVID-19 as a worldwide health-related public concern. It helps researchers better understand the importance of social media in sharing COVID-19 research and other scientific issues. This paper provides insight into the impact of COVID-19 research on social media. As a practical implication, it is recommended that altmetric measures be used in urgent medical research as complementary to traditional citation-based bibliometrics.

Declarations

Acknowledgement

NA

Conflicts of Interests

The authors declare that they have no competing interests.



Ethical statement

This study has been ethically approved by the Ethics Committee of Hamadan University of Medical Sciences (Code number: IR.UMSHA.REC.1399.381).

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Authors' contributions

S. B. presented the idea and reviewed the manuscript. H.M. actively contributed to elements of the study and drafted the manuscript. M. K. S and A. O. developed the research idea, designed the study, gathered data, analyzed data, and managed the research. B. H. and A. G. contributed to the study design and reviewed the manuscript.

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