

Top COVID-19 100 vaccine papers: An Altmetric study

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Abstract - The high number of COVID-19 studies has attracted scholars to produce many studies on the topic. However, while we know the impact of these studies on academia by analyzing their citation score in different indexing outlets, little is known about their impact on social networks. The current study aims to measure the impact of the top 100 vaccination papers on social networks. An Altmetrics analysis is conducted to measure the Altmetrics attention scores of the paper. We retrieved the data through the Web of Science and Scopus. The researchers selected Altmetric.com as a tool to obtain social media and mainstream internet outlet counts. The findings of the study revealed that there is a significant correlation between the citations and Altmetric indicators. Our findings indicate that Twitter and Mendeley represent the most contributes social networks in the final AAS in almost all journals included in the study. The study's findings have confirmed that COVID-19 vaccination papers have gained many citations and attention on social networks.

The study's main limitation is that it only measured the Altmetrics score for the top 100 papers. Hence, while the current paper gave us insight into the performance of vaccination papers on the social web, there is a need to conduct further studies covering a larger sample.

Keywords: Covid-19 – Scholarly publishing – Vaccines – Altmetric scores

Introduction

COVID-19 pandemic might be the most discussed topic in 2020 and 2021 because of the impact of this pandemic on people's life. Thousands of papers have been published about the virus resulting in increased attention from scholars and the public [1]. The purpose of the papers is to mitigate the COVID-19 effect by answering questions related to the treatment of the side effects of the virus. In order to explore the impact of scholarly papers on social networks and research in general, studies were carried out using Altmetrics to find how social networks contributed to the spread of the virus research [2-5].

Traditional citation indexes such as Scopus and WoS might not be enough to learn about the importance of the published research. Even in the COVID-19 case, which received high attention from the scholarly community, there is a need to find how scholars and others engage with research when it is published. Altmetrics provided us with exceptional tools that give us insight into the papers and predict the performance of these papers in terms of citation count. Vaccines studies are not an exception, as Altmetrics can help identify papers with the highest

engagement on social networks and predict which papers are important for the scholarly community.

This paper focuses on the above issues by analyzing the top 100 vaccine papers published from 2020 to May 2021. The paper tries to find a correlation between Altmetrics' score and the number of citations of vaccine papers. Additionally, the paper presents the characteristics of engagement with these papers on different social network outlets. The paper also tries to find if Altmetrics indicators can predict the future citation impact of the vaccines' papers.

Literature

The COVID-19 pandemic has been accompanied by a boom of publications that aimed to research the virus and its impact. However, with the number of publications increasing, it becomes difficult for researchers to distinguish the quality publications in the area. As a result, many researchers explored the importance of these publications using bibliometrics and Altmetrics analysis [1, 2, 6].

The bibliometric and Altmetrics studies aimed to understand the impact of the coronavirus research by analyzing the number of citations and people's engagement on social networks. For example, a study by Edakar and Shehata [1] aimed to measure the covid-19 research on social media. The study analyzed the Altmetrics scores of papers published between 2019 and 2021. The findings of the study revealed that Altmetrics could help to understand the social impact of covid-19 papers. Parabhoi [6] analyzed the Altmetrics of the top papers published about the virus. The study, alongside Moezinia [7], showed that Twitter was the most dominating network sharing scholarly research outputs. Moreover, the paper indicated that China is considered the top country in producing scholarly

research, followed by the USA. Uysal, Islamoglu [8] also analyzed the top papers. The findings revealed that the citation count of the papers is not necessarily a good indicator of the performance, and other metrics measures should be incorporated in order to be able to understand how people engage and react to specific scholarly research.

Other publications' characteristics also were measured using bibliometric and Altmetrics analysis. For example, Mahmoudi [9] found that most of the top papers' authors about the virus are males, while women represented a small percentage of the papers. Batooli and Sayyah [10] showed that one of the characteristics of the virus research is that a significant portion of the authors is from China and Japan. The study also revealed a correlation between Altmetrics and bibliometrics, which means that Altmetrics can serve as an indicator of papers performance and citation count.

Regarding the vaccine, Zhang, Xiong [11] analyzed the bibliometrics of the top 100 papers about the vaccine. The papers revealed that the top papers were published in 32 journals and scored citations ranging from 593 to 2406. Interestingly, the new England journal of medicine published the highest number of papers regarding the vaccine. Notably, unlike other studies that explored covid-19 publications, the USA was the top country producing research about the vaccine, followed by Switzerland, then England.

Methodology

This study is a descriptive-analytical study that uses altmetric analysis to answer the research questions. Web of Science was used to collect the data and obtain a comprehensive sample of publications. We used this search strategy was selected because it covers a wide range of publications, thereby increasing the research scope. The data retrieved

consisted of papers, citations of these papers, and altmetrics data. The data collection was carried out in two phases. The first phase mainly focused on retrieving all papers related to COVID-19. The researchers used an advanced search option in Scopus to retrieve all COVID-19 vaccine papers indexed by Scopus from 2020 to 20 May 2021. We used this search strategy : TS= ("corona*" OR "2019-nCoV" OR "nCoV-19" OR "SARS-CoV-2" OR "SARS-CoV2" OR "COVID*") AND TI= ("vacc*" OR "immuniz*"). In total, 4054 publications were retrieved in May 2021. The results were limited to research articles in English (removing reports, editorials, book reviews, etc.). The publication years were set as 2020 and 2021. The articles before 2020 were excluded. Articles number in May 2021 were 1643. They were sorted in descending order of citation times.

The 100 top-cited (T100) COVID-19 vaccine studies were identified by citation times. Next, the data were imported into Microsoft Excel 2016. The citation count in Scopus (We used this search strategy : TITLE ("corona*" OR "2019-nCoV" OR "nCoV-19" OR "SARS-CoV-2" OR "SARS-CoV2" OR "COVID*") AND TITLE ("vacc*" OR "immuniz*")), and Dimensions (We used this search strategy : ("corona*" OR "2019-nCoV" OR "nCoV-19" OR "SARS-CoV-2" OR "SARS-CoV2" OR "COVID*") AND ("vacc*" OR "immuniz*")) was harvested from the corresponding databases and was updated on 20 May 2021.

The second phase aimed to measure the presence of the papers retrieved on social media. To perform this measurement, the researchers chose Altmetric.com as a tool to obtain social media and mainstream internet outlet counts. This tool was selected because it was considered the most comprehensive altmetric tool on the internet

The tool is a service provided for researchers by Altmetric.com to give them insight into the papers. The researchers used the papers' DOI to collect data by using Altmetric.com. Altmetric.com provided a complete record of all the shares and mentions of every paper. Hence, it enabled the researchers to identify the research articles with the highest altmetric scores. Subsequently, the collected data were stored separately in two Excel files.

Analysis

Table 1 shows the top 100 papers that were published in 35 journals. Notably, the journal with the highest number of articles that were authored about the vaccines was New England Journal of Medicine (n = 9), followed by The Lancet (n=8), Nature (n=7), Cell(n=7), and MMWR-Morbidity And Mortality Weekly Report (n=6).

As highlighted in the table, the New England Journal of Medicine had the highest citation score in the web of science as the papers were cited 1720 times and 2192 times in Scopus. Notably, the journal had the highest dimension citations (4359), but it was ordered second in the Altmetric attention score (AAS) with only 70351 AAs. The Lancet was ordered second in terms of the number of citations in WoS (1397), Scopus (1676), and Dimension (2723), but the journal had the highest AAS score (89205).

The data shows that the number of journals that achieved more than 50000 AAS in the topic of the COVID-19 vaccine is two journals, while six journals (Nature, Science, Vaccine, MMWR-Morbidity, and Mortality Weekly Report, Lancet Infectious DISEASES and CELL) had more than 6000 AAS. Notably, nineteen journals out of 35 had AAS less than 500, which means that 54% of the extracted journals did not achieve high AAS.

TABLE 1 Summary statistics for Altmetric Attention Score (mean), citation count in Dimensions (mean), Scopus (mean) and Web of Science (mean), and number (*N*) of articles per journal

Journals	Number of articles	WOS Citations	Mean	Scopus citations	Mean	Dimensions Citations	Mean	Altmetric Attention Score total	mean
Total number of citations	100	9049		10810		17766		236729	
NEW ENGLAND JOURNAL OF MEDICINE	9	1720	191.11	2192	243.55	4359	484.33	70351	7816.77
LANCET	8	1397	174.62	1676	209.50	2723	340.37	89205	11150.63
NATURE	7	776	110.85	887	126.71	1613	230.42	12418	1774
CELL	7	371	53	445	63.57	760	108.57	6544	934.85
MMWR-MORBIDITY AND MORTALITY WEEKLY REPORT	6	282	47	341	56.83	492	82	9244	1540.66
SCIENCE	5	662	132.40	803	160.60	1269	253.80	10628	2125.60
VACCINE	5	156	31.20	192	38.40	357	71.40	9722	1944.40
LANCET INFECTIOUS DISEASES	5	228	45.60	281	56.20	437	87.40	6911	1382.20
NATURE COMMUNICATIONS	4	244	61	294	73.50	444	111	1636	409
EUROPEAN JOURNAL OF EPIDEMIOLOGY	4	126	31.50	160	40	285	71.25	220	55
JOURNAL OF BIOMOLECULAR STRUCTURE & DYNAMICS	4	195	48.75	215	53.75	268	67	78	19.50
NPJ VACCINES	3	135	45	155	51.66	215	71.66	387	129
HUMAN VACCINES & IMMUNOTHERAPEUTICS	3	86	28.66	106	35.33	185	61.66	59	19.66
FRONTIERS IN IMMUNOLOGY	3	73	24.33	88	29.33	170	56.66	32	10.66
PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA	2	116	58	126	63	213	106.50	4356	2178
NATURE MEDICINE	2	122	61	132	66	286	143	3188	1594
JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	2	136	68	161	80.50	262	131	2118	1059
JOURNAL OF INFECTIOUS DISEASES	2	162	81	179	89.50	226	113	1800	900
MICROBIAL PATHOGENESIS	2	78	39	96	48	114	57	1099	549.50
COMPUTERS IN BIOLOGY AND MEDICINE	2	93	46.50	111	55.50	144	72	41	20.50
EBIOMEDICINE	1	95	95	108	108	138	138	3948	3948
ACS CENTRAL SCIENCE	1	371	371	426	426	501	501	1155	1155
CELLULAR & MOLECULAR IMMUNOLOGY	1	400	400	434	434	618	618	363	363

CELL HOST & MICROBE	1	22	22	26	26	61	61	229	229
ANNALS OF INTERNAL MEDICINE	1	46	46	58	58	134	134	221	221
VIRUSES-BASEL	1	364		405		571		198	
PATHOGENS	1	47	47	60	60	89	89	193	193
CURRENT TROPICAL MEDICINE REPORTS	1	174	174	206	206	248	248	162	162
IMMUNITY	1	30	30	37	37	61	61	128	128
EUROSURVEILLANCE	1	22	22	25	25	57	57	43	43
DRUG DEVELOPMENT RESEARCH	1	27	27	34	34	36	36	39	39
JOURNAL OF MEDICAL VIROLOGY	1	118	118	139	139	180	180	6	6
CHAOS SOLITONS & FRACTALS	1	110	110	133	133	141	141	4	4
BIOMED RESEARCH INTERNATIONAL	1	35	35	43	43	59	59	3	3
VACCINES	1	30	30	36	36	50	50	0	0
Mean per published item		90.49		108.1		177.66		2367.29	

Note: The total number of citations in each database and AAS and the mean score per item are presented.

Table 2 breaks down which social media had contributed most to the altimetric attention score of each journal. Twitter users were the most popular data in all journals with a score of 252037. Twitter was followed by Mendeley readers which had a score of 57545. The difference between Twitter and Mendeley is very significant as Twitter contributed 78% AAS while Mendeley contributed 17.8% of the total AAS. Notably, policy sources, peer review sites, and research highlight platforms had low AAS.

It is notable for the reader that Lancet has achieved the highest AAS on Twitter with a score of 103772. New England Journal of Medicine ordered second in Twitter but was with the highest AAS in Mendeley with a score of 13518. Lancet, on the other hand, was ordered second in Mendeley with a score of 9652. The table also shows that only one journal (Vaccines) scored zero on Twitter, but it scored 55 on Mendeley, which is considered the lowest score in Mendeley.

TABLE 2 Summary statistics for different social media networks of articles per journal

Journals	Number of articles	News outlets	Blogs	Policy source	Twitter	Peer review site	Facebook	Wikipedia	Reddit	Research highlight platform	Video uploads	Mendeley	Altmetric Attention Score
Total	100	10913	1032	60	252037	8	671	122	257	21	193	57545	236729
LANCET	8	3623	281	9	103772	2	172	35	81	4	59	9652	89205
NEW ENGLAND JOURNAL OF MEDICINE	9	2794	299	6	87295	5	223	26	62	5	76	13518	70351
VACCINE	5	107	6	2	11950	0	85	2	8	0	8	1307	9722
SCIENCE	5	474	51	1	11492	0	23	1	14	2	2	2014	10628
NATURE	7	642	91	7	10099	1	27	9	29	3	17	3695	12418
CELL	7	392	42	2	5543	0	9	3	19	3	2	2073	6544
PROCEEDINGS OF THE	2	194	15	2	4959	0	8	1	9	1	2	514	4356

NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA													
MMWR- MORBIDITY AND MORTALITY WEEKLY REPORT	6	809	75	9	3721	0	33	14	5	0	1	1134	9244
LANCET INFECTIOUS DISEASES	5	501	27	4	3628	0	5	10	4	0	12	1760	6911
EBIOMEDICINE	1	316	22	1	2137	0	19	2	4	0	4	731	3948
JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	2	123	20	3	2077	0	7	5	2	0	3	888	2118
MICROBIAL PATHOGENESIS	2	94	5	0	1147	0	1	0	8	0	0	431	1099
ACS CENTRAL SCIENCE	1	63	9	0	854	0	12	6	0	1	1	1970	1155
NATURE COMMUNICATIONS	4	137	16	2	715	0	6	1	4	0	0	1217	1636
JOURNAL OF INFECTIOUS DISEASES	2	146	21	1	673	0	5	3	1	0	2	1156	1800
NATURE MEDICINE	2	344	25	4	580	0	6	0	5	0	0	1203	3188
PATHOGENS	1	2	1	0	221	0	0	1	0	0	1	263	193
NPJ VACCINES	3	23	4	0	216	0	0	0	0	0	0	922	387
IMMUNITY	1	2	0	0	196	0	0	0	0	0	0	208	128
ANNALS OF INTERNAL MEDICINE	1	12	3	1	179	0	1	0	0	0	0	350	221
CURRENT TROPICAL MEDICINE REPORTS	1	10	2	2	92	0	2	2	0	0	1	1148	162
CELL HOST & MICROBE	1	23	1	0	84	0	0	0	1	0	0	130	229
VIRUSES-BASEL	1	16	4	1	76	0	20	0	0	0	0	1897	198
CELLULAR & MOLECULAR IMMUNOLOGY	1	34	5	1	74	0	0	0	0	1	0	1772	363
EUROPEAN JOURNAL OF EPIDEMIOLOGY	4	19	3	2	50	0	0	1	0	0	1	1779	220
FRONTIERS IN IMMUNOLOGY	3	1	0	0	41	0	0	0	0	0	0	954	32
COMPUTERS IN BIOLOGY AND MEDICINE	2	1	0	0	39	0	0	0	0	0	1	1445	41
JOURNAL OF BIOMOLECULAR STRUCTURE & DYNAMICS	4	0	1	0	37	0	5	0	0	1	0	729	78
EUROSURVEILLANCE	1	0	1	1	31	0	0	0	0	0	0	226	43
HUMAN VACCINES & IMMUNOTHERAPEUTICS	3	4	0	1	24	0	2	0	1	0	0	1122	59
JOURNAL OF MEDICAL VIROLOGY	1	0	0	0	7	0	0	0	0	0	0	676	6

CHAOS SOLITONS & FRACTALS	1	0	0	0	4								
BIOMED RESEARCH INTERNATIONA L	1	0	0	0	3								
DRUG DEVELOPMENT RESEARCH	1	5	0	0	1								
VACCINES	1	0	0	0	0								

Table 3 Characteristics of the top 10 articles with the highest citations of the COVID-19 Vaccine field in the various social media

Article	Journal/year	WOS citat ion	Scopus citat ion	Dimension s	News outlet s	Blogs	Policy sourc e	Tweeter s	Peer revie w site	Faceboo k	Wikipedi a	Redditor s	Researc h highligh t platform	Video uploader s	Mendele y	Altmetric Attention Score
Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine	NEW ENGLAND JOURNAL OF MEDICINE/2020	454	654	1252	642	73	1	21429	1	61	9	8	1	27	4528	19811
Safety and immunogenicity of the ChAdOx1 nCoV-19 vaccine against SARS-CoV-2: a preliminary report of a phase 1/2, single-blind, randomized controlled trial	LANCET/2020	364	423	641	883	62	2	16290	1	41	5	19	1	9	2052	15586
An mRNA Vaccine against SARS-CoV-2-Preliminary Report	NEW ENGLAND JOURNAL OF MEDICINE/2020	415	540	888	721	82	2	16386	1	56	4	19	1	20	2411	14635
Efficacy and Safety of the mRNA-1273 SARS-CoV-2 Vaccine	NEW ENGLAND JOURNAL OF MEDICINE/2021	237	289	754	246	34	1	10273	0	39	5	5	1	10	1743	7741
Safety, tolerability, and immunogenicity of a recombinant adenovirus type-5 vectored COVID-19 vaccine: a dose-escalation, open-label, non-randomized, first-in-human trial	LANCET/2020	331	380	525	295	36	2	7827	0	35	3	32	1	3	1230	6989
DNA vaccine protection against SARS-CoV-2 in rhesus macaques	SCIENCE/2020	251	337	488	126	23	0	4908	0	4	0	2	1	0	666	3462
Development of an inactivated vaccine candidate for SARS-CoV-2	SCIENCE/2020	299	338	515	102	12	1	4047	0	16	1	4	1	1	830	3448

Research and Development on Therapeutic Agents and Vaccines for COVID-19 and Related Human Coronavirus Diseases	ACS CENTRAL SCIENCE/2020	371	426	501	63	9	0	854	0	12	6	0	1	1	1970	1155
Characterization of the receptor-binding domain (RBD) of 2019 novel coronavirus: implication for development of RBD protein as a viral attachment inhibitor and vaccine	CELLULAR & MOLECULAR IMMUNOLOGY/ 2020	400	434	618	34	5	1	74	0	0	0	0	1	0	1772	363
Preliminary Identification of Potential Vaccine Targets for the COVID-19 Coronavirus (SARS-CoV-2) Based on SARS-CoV Immunological Studies	VIRUSES-BASEL/2020	364	405	571	16	4	1	76	0	20	0	0	0	0	1897	198

The characteristics of the top 10 papers that received the highest citation score are outlined in Table 3. The first paper was published in the New England Journal of Medicine in 2020. The paper scored 454 in WoS and 654 in Scopus. Notably, the paper also had the highest AAS as it scored 19811. The third paper, which scored a high score in both WoS and Scopus, was published in the same journal with 415 and 540, respectively. The paper also scored high AAS 14635. The second paper was published in The Lancet journal.

the table, except for the first three papers, no other papers had AAS higher than 10000. While some of the papers ranked in the top ten papers had almost similar citation scores in WoS and Scopus as the first two papers, non-had high AAS score as the score for the eight papers ranged from 1000 to 155 AAS. The results indicate that even though these papers had high scores, they did not significantly affect social media and informal outlets. Also, this is an indicator that the first two papers which were published in the same date range, had more attention than other papers.

Table 4 Presence of Covid-19 vaccine papers research publications at Altmetric per year

year	Number of Publications	WOS citation	Mean	Scopus citation	Mean	Dimensions	Mean	Alemetric attention score	Mean
2020	87	8143	93.60	9688	111.36	15309	175.97	156467	1798.47
2021	13	906	69.69	1122	86.31	2457	189.00	80262	6147.00

Table 4 outlines the presence of Covid-19 vaccine papers at Altmetric per year. We found that in 2020, the number of published papers about the vaccine with a high Altmetrics score was 87. The total Altmetrics attention score for these papers was 156467.

May 2021. The data confirms an increased interest in COVID-19 vaccine papers because of the distribution of around five vaccines during this period (Pfizer, Moderna, Johnson & Johnson's Janssen, Sinovac, and Sinopharm).

Table 5 Spearman correlations between WOS citation counts and altmetrics for all papers of COVID-19 vaccine

[illegible]

Dimensions citation	.900**	.903**	1	.641**	.769**	.307**	.433*	.360**	.635*	.426**	.453*	.438*	.560*	.792**	.614*
	.000	.000		.000	.000	.002	.000	.000	.000	.000	.000	.000	.000	.000	.000
News outlets	.545**	.581**	.641**	1	.938**	.399**	.707*	.527**	.659*	.598**	.661*	.458*	.781*	.673**	.856*
	.000	.000			.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Blogs	.659**	.704**	.659**	.938**	1	.417**	.676*	.546**	.703*	.625**	.696*	.534*	.817*	.747**	.821*
	.000	.000				.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Policy source	.303**	.293**	.307**	.399**	.417**	1	.065	.084	.221*	.073	.282*	.137	.227*	.259**	.187
	.002	.003					.518	.408	.027	.472	.005	.175	.024	.009	.062
Tweeter s	.318**	.356**	.433**	.707**	.676**	.065	1	.328**	.659*	.547**	.593*	.485*	.630*	.491**	.960*
	.001	.000						.001	.000	.000	.000	.000	.000	.000	.000
Peer review site	.320**	.322**	.360**	.527**	.546**	.084	.328*	1	.413*	.399**	.400*	.300*	.459*	.351**	.369*
	.001	.001							.000	.000	.000	.002	.000	.000	.000
Facebook	.560**	.564**	.635**	.659**	.703**	.221*	.659*	.413**	1	.569**	.741*	.458*	.690*	.540**	.872*
	.000	.000								.000	.000	.000	.000	.000	.000
Wikipedia	.393**	.400**	.426**	.598**	.625**	.073	.547*	.399**	.569*	1	.493*	.253*	.675*	.412**	.598*
	.000	.000									.000	.011	.000	.000	.000
Redditors	.349**	.356**	.453**	.661**	.696**	.282**	.593*	.400**	.741*	.493**	1	.427*	.630*	.348**	.832*
	.000	.000										.000	.000	.000	.000
Research highlight platform	.385**	.386**	.438**	.458**	.534**	.137	.485*	.300**	.458*	.253*	.427*	1	.377*	.413**	.453*
	.000	.000											.000	.000	.000
Video uploads	.458**	.464**	.560**	.781**	.817**	.227*	.630*	.459**	.690*	.675**	.630*	.377*	1	.570**	.706*
	.000	.000												.000	.000
Mendeley	.731**	.734**	.792**	.673**	.747**	.259**	.491*	.351**	.540*	.412**	.348*	.413*	.570*	1	.516*
	.000	.000													.000
Altmetric Attention Score	.501**	.509**	.614**	.856**	.821**	.187	.960*	.369**	.872*	.598**	.832*	.453*	.706*	.516**	1
	.000	.000													

Table 5 shows Spearman correlations between WoS citation counts and Altmetrics for all papers of COVID-19 vaccine. The correlation test results revealed a significant positive and moderate correlation between the WoS citations and Altmetrics in all social networks outlets. The correlation was strong in number of readers of papers in Dimensions (p=0.000 and r = 0.999**), News outlets (p=0.000 and r = 0.545**), Policy source (p=0.000 and r = 0.821**), blogs (p=0.000 and r = 0.659**), Facebook (p=0.000 and r = 0.560**), and Mendeley (p=0.000 and r = 0.731**).

The results Also showed moderate relation in Twitter (p=0.001 and r = 0.318**), Peer review site (p=0.001 and r = 0.320**), Wikipedia (p=0.000 and r = 0.393**), Redditors (p=0.000 and r = 0.349**), Research highlight platform, and Video uploaders. Similar correlation was visible between Scopus and social networks. In contrast, the correlation test results revealed a weak negative relationship between some social media outlets (Blocks in Gray). For instance, a negative correlation was clear between the policy sources and social outlets such as, Tweeter (p=0.065 and r = 0.518), peer reviewed

sites ($p=0.084$ and $r = 0.408$), Wikipedia ($p=0.073$ and $r = 0.472$), and Research highlight platform ($p=0.137$ and $r = 0.145$).

Discussion

This research aimed to describe and analyze the citations and Altmetrics scores of scientific production about COVID-19 vaccines. The topic has attracted many scholars in 2020 and 2021 because of the spread of the virus and the competition between the pharmaceutical companies in producing a vaccine for the virus. To our best knowledge, this is the first study to report on Altmetric results about the vaccines papers authored during 2020\2021. We decided to only limit our research to the top 100 papers on the topic to examine the performance of these papers on social networks. The study's findings indicated that the top two journals in the number of publications on the topic had achieved the highest citation and AAS score. All of the papers except one had AAS; that is, the highest and lowest AAS for these articles were 19811 and 0, respectively.

The findings of the study revealed that there is a significant correlation between the citations and Altmetric indicators. Additionally, it was found that there is a positive correlation between social media platforms. Notably, the papers that were extracted in this study were published in 2020 and 2021; that is, these papers did receive much attention from the scholarly community and the public on social media as the topic is one of the hot topics in this period. All papers had citations, and all papers were mentioned in one or more social networks that indicate the topic's importance. Similar studies that analyzed the performance of COVID-19 papers indicated the same results [1, 10, 12].

Our findings indicate that Twitter and Mendeley contributed the most in the final AAS in almost all journals included in the study. Notably, many studies have reached the same conclusion as the volume of users of Twitter and Mendeley is high, which makes the chances of noticing the papers on these networks higher from the users. Additionally, Twitter is a public social network that increases the chances that non-scholars read and share information about the papers [13]

Conclusion

The spread of the COVID-19 pandemic, followed by the number of vaccines developed to protect people from the dangerous effect of the virus, has motivated researchers to publish many studies on the topic. Thus, this momentum of research papers has led to more attention from scholars and the public toward vaccine research. Social networks were among the best outlets to discuss these papers and share scholarly results regarding the vaccine with others. We extracted the 100 scholarly outputs most cited on WoS and Scopus and shared by a broad audience of scientists and people on social networks. The findings indicated that a correlation between traditional citation analysis and altmetrics analysis of vaccine articles. The findings have confirmed that despite that these papers were published recently in 2020 and 2021, they have gained many citations and attention on social networks.

Social networks have contributed to taking the scholarly papers out of journals and presenting their results to the public. Social networks have made research more visible and accessible to the public, increasing the advance of research in many areas. Hence, this result illustrates the importance of integrating social networks in disseminating research and contributing to the increase in

Altmetrics attention scores, which would later reflect on the citations count.

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