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Pro-Metrics

ORIGINAL ARTICLE

Social attention to the scientific publications on mHealth research during Covid-19 outbreak: An altmetric study

Bwsrang Basumatary[1], Sumeer Gul[2], Manoj Kumar Verma[3]

[1] Department of Library and Information Science, Mizoram University, Aizawl, 796004, India.
[2] Department of Library and Information Science, University of Kashmir, India.
[3] Department of Library and Information Science, Mizoram University, Aizawl, 796004, India.
Email: manojdlis@mzu.edu.in. **ORCID:** https://orcid.org/0000-0002-3009-3258.
Corresponding author.

ABSTRACT

Objective. This study aimed to assess the social attention received by the top 100 highly cited scientific publications focusing on mHealth (mobile health) research during the Covid-19 outbreak.

Design/Methodology/Approach. This study employed altmetric tools to assess the social attention received by mHealth research publications. The study collected bibliographical data from the Scopus database of the top 100 highly cited articles published between 2019 and 2022. Altmetric data was collected from the Dimensions.ai database and analyzed using MS Excel, Tableau, and SPSS software.

Results/Discussion. The study found that mHealth research has received significant social attention from various social media, mass media, and reference manager platforms. However, it needs to be promoted in order to reach a wider audience. Twitter was the leading channel for disseminating research highlights on mHealth, and articles have many readers on the Mendeley platform. However, correlation analysis revealed a weak positive correlation between citation and AAS of mHealth research publications.

Conclusions. The study contributes to understanding the societal impact of mHealth research during the COVID-19 outbreak and emphasizes the role of Altmetric tools in assessing social attention in scientific publications. The study concludes by suggesting future research directions in the field.

Keywords: mHealth; mobile health; social attention; altmetrics; COVID-19; telemedicine.

1. INTRODUCTION

In the wake of the COVID-19 pandemic, the world witnessed an unprecedented surge in the production and dissemination of scientific publications. The urgent need for research and solutions to combat the virus led to a remarkable acceleration in the scientific community's efforts, resulting in an overwhelming influx of studies across various disciplines. One field that experienced a significant upswing in attention and interest during this time was mobile health, commonly known as mHealth.

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mHealth, a branch of healthcare that leverages mobile devices and wireless technology to deliver healthcare services and information, emerged as a critical domain amidst the pandemic. With the widespread adoption of smartphones and the increasing availability of internet connectivity, mHealth tools and applications proved valuable assets in addressing the healthcare challenges posed by COVID-19. These technologies facilitated remote patient monitoring, contact tracing, symptom tracking, telemedicine consultations, and disseminating vital health information to the public.

Due to the large volume of mHealth-related research, assessing these publications' impact and reach is crucial. Traditional bibliometric measures, such as citation counts, have long been used to evaluate scholarly impact. However, in the era of social media and online engagement, it is equally important to consider alternative metrics that capture the broader social attention and influence of scientific work. Altmetrics, a set of alternative indicators, emerged as a promising tool to assess the social attention and dissemination of scientific research across various platforms, including social media, news outlets, blogs, and online reference managers.

This study explores the social attention received by scientific publications focused on mHealth during the COVID-19 pandemic using Altmetric tools. By analyzing the altmetric data associated with these publications, we can gain insights into the reach, visibility, and societal impact of mHealth research. Furthermore, examining the relationship between altmetric and traditional citation-based metrics can help us understand the interplay between scholarly impact and social attention.

Several literature reviews and research evaluations on mHealth-related publications have been conducted. For instance, a study analyzed performance measurement and scientific mapping of academic publications on mHealth research for COVID-19 and revealed that the United States contributed the most research to the field (To & Lee, 2023). A study systematically reviewed the mHealth adoption research in COVID-19 outbreaks and provided suggestions for future research to tackle it (Alam *et al.,* 2023). Studies were also conducted to provide a holistic picture of the available mHealth apps that have been developed to combat the COVID-19 pandemic (Singh *et al.,* 2020), the impact of using mHealth apps (Cao *et al.,* 2022), mHealth monitoring of pediatric bronchial asthma (Dauletbaev *et al.,* 2022). A review article highlighted the transformation in clinical practice during the post-COVID era and the need for future medical revolutions (Sabetkish & Rahmani, 2021). Similarly, a study analyzed published articles on mHealth apps from 2020 to February and mapped the relationship between mobile app technology and healthcare during the COVID-19 outbreak (El-Sherif & Abouzid, 2022). Researchers also conducted a follow-up qualitative study of online articles and reviews on mHealth during the COVID-19 pandemic to cross-validate the results and explain the antecedents and effects of mHealth (Jin *et al.,* 2022).

A few altmetric based studies analyzed the social attention to the COVID-19 related articles (Vysakh & Babu, 2020; Valderrama-Baca *et al.,* 2023). In addition, a study was carried out to measure the impact of the top 100 vaccination papers on social networks (Shehata *et al.,* 2021). Further, the study examined sharing of retracted COVID-19 articles on social media and mass media (Shamsi *et al.,* 2022). However, no study analyzed the social attention paid to the research publications on mHealth, especially during the COVID-19 outbreak. Social attention to mHealth research during COVID-19 is essential to understand the role of mHealth apps in the pandemic, identifying the preconditions for technology adoption, and providing insights for future research.

2. OBJECTIVES OF THE STUDY

The objectives of the present study are-

I. to analyze the year-wise distribution of publications, citations, and altmetric attention score (AAS) of the top 100 highly cited articles on mHealth during the COVID-19 outbreak;
II. to identify the key scientific players of the top 100 highly cited articles;
III. to assess the dissemination pattern of research highlights through various social webs and social attention to the top 100 highly cited articles;
IV. to analyze the correlation between citation and AAS of the top 100 highly cited articles.

3. MATERIALS AND METHODS

We performed an altmetric analysis of scientific publications on mHealth during the COVID-19 pandemic indexed in the Scopus database between 2020 and 2022. The sample size of our study was the top 100 highly cited articles published during that period.

A bibliographic search was performed on May 17, 2023, using the controlled MeSH (Medical Subject Headings) and its entry terms. The search terms used were - "mHealth" OR "eHealth" OR "mobile health" OR "telemedicine" AND "COVID-19" in the "Article Title" section of the Scopus database. In order to identify the core research publication on mHealth, the "Article Title" field was selected for searching for bibliographic data in the Scopus database because the title of a research article is a key indicator of the concept of the paper, and it is the first opportunity to attract the reader's attention and advertise the article (Eassom, 2017; Tullu, 2019). Without filtering, 1,691 document results were published between 2020 and 2023. The present study selected only the top 100 highly cited articles published between 2020 and 2022, as this period was regarded peak of the outbreak, and later on, the World Health Organization declared that COVID-19 was no longer a global health emergency on May 5, 2023, (WHO, 2023; NPR, 2023).

Altmetric data was collected from the Dimensions.ai database. It is considered the world's largest linked research information dataset comprising 135 million publications maintained by Digital Science & Research Solutions that provides altmetric attention data based on the Altmetric.com database (Verma & Yuvaraj, 2022; Dimensions, 2023; Basumatary *et al.,* 2023). We used the respective articles' Digital Object Identifier (DOI) to obtain the social media metrics. First, we picked up the DOI of each article and pasted it into the search box in the Dimensions.ai database in the DOI section. Based on the search result, the social media metrics of each article have been copied manually into the MS Excel sheet for further analysis.

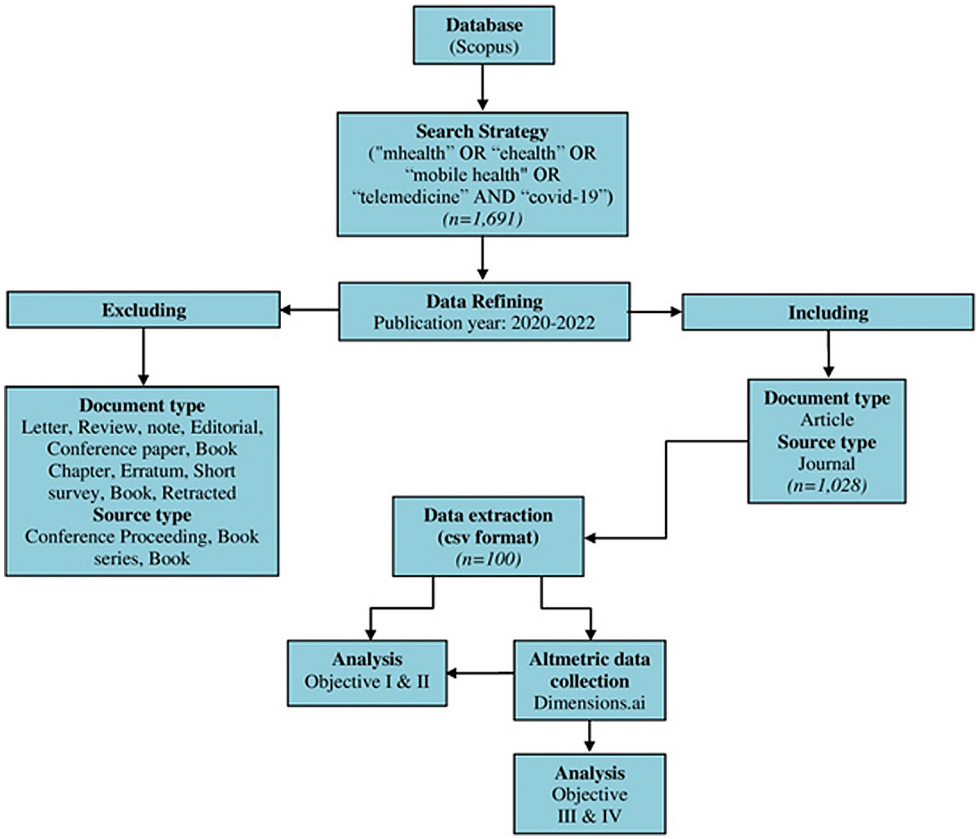

Figure 1. Research methodology workflow.

Initially, the performance analysis was conducted based on Scientometric parameters using the indicators such as the authors, affiliations and number of publications. It was followed by the altmetric analysis of the top 100 highly cited articles. The study used MS Excel, Tableau, and SPSS to analyze data and visualize the results. The correlation between citation and AAS was computed using Pearson Correlation techniques using IBM SPSS software based on the range of Pearson correlation coefficient (r) strengths presented in Table 1. The exact value was used by previous researchers, Meghanathan *et al.* (2016), Liang *et al.* (2019), and Basumatary *et al.* (2023).

Range of CCV	Level of Correlation	Range of CCV	Level of Correlation
0.80 to 1.00	Very Strong Positive	-1.00 to -0.80	Very Strong Negative
0.60 to 0.79	Strong Positive	-0.79 to -0.60	Strong Negative
0.40 to 0.59	Moderate Positive	-0.59 to -0.40	Moderate Negative
0.20 to 0.39	Weak Positive	-0.39 to -0.20	Weak Negative
0.00 to 0.19	Very Weak Positive	-0.19 to -0.01	Very Weak Negative

Table 1. Range of correlation coefficient values (CCV).

4. RESULTS AND DISCUSSION

4.1. Year-wise distribution of the top 100 highly cited articles, citations, and AAS

Table 2 illustrates the top 100 highly cited articles on mHealth-related research publications during the COVID-19 pandemic. The total number of citations and AAS were also presented in the table. The most number of publications were reported in the year 2020 (NP=71), which received the most number of citations (TC=6,844) and AAS (5,029). It was followed by 2021 (NP=28, TC=1,563, AAS=2,351) and 2022 (NP=1, TC=52, AAS=4). The disease outbreak was first reported in December 2019 when the first human cases of COVID-19 were identified in Wuhan, China (Zhu *et al.,* 2020; Wikipedia, 2023). On January 30, 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a Public Health Emergency of International Concern (WHO, 2020; CNN, 2023). On May 5, 2023, the World Health Organization (WHO) declared that COVID-19 is no longer a global health emergency (WHO, 2023; NPR, 2023). The number of publications was dominant in 2020 because the peak of the COVID-19 outbreak was in 2020 (Wu *et al.,* 2020; AJMC, 2021). The mHealth became popular in 2020 and 2021 due to the total lockdown of the city and unable to access health services physically. The COVID-19 pandemic increased the reliability of patients on mHealth apps to take an active and informed role in their healthcare. The pandemic also increased the usage of mHealth apps among the Chinese population (Yang *et al.,* 2023). Due to the pandemic, people could not visit hospitals and clinics, so they turned to mHealth apps for remote consultations with doctors and other healthcare providers (Bhaskar & Rao, 2022). Identifying the most influential research on mHealth during COVID-19 can provide valuable insights into the role of mHealth in healthcare during pandemics. It can help determine future perspectives to improve infectious disease control and present innovative healthcare solutions (El-Sherif & Abouzid, 2022).

Year	No. of Publication (NP)	Total Citation (TC)	Altmetric Attention Score (AAS)
2020	71	6,844	5,029
2021	28	1,563	2,351
2022	1	52	4

Table 2. Year-wise distribution of the top 100 highly cited articles on mHealth.

4.2. Most prolific researchers

160 authors contributed the top 100 highly cited research articles. Table 3 presents the list of researchers with at least two publications related to mHealth during the COVID-19 pandemic. As seen in the table, four authors have participated and contributed three papers, twenty-three authors have two publications, and the rest have

one publication each. It is found that some of the authors have collaboratively worked on a single article, which is counted as equal credit and assigned in the same rank (Table 3). Researchers affiliated with the United States were the leading contributor to the field. Researchers from Australia, Poland, Canada, Chile, the United Kingdom, and India also contributed their scientific publications. Although the researchers' original nationalities might differ, the affiliation they are currently associated with is sourced from their Scopus author profile. The United States is known for its strong research infrastructure, robust funding opportunities, and advanced healthcare system. These factors contribute to the country's prominence in mHealth research, resulting in more publications than in other nations. Previous researchers also highlighted that highly structured app-mediated medical research is presently most prominent among American researchers and institutions (Lang *et al.,* 2020). MHealth and COVID-19 found that researchers in the US produced the most articles on the topic (To & Lee, 2023).

Rank	Author	Affiliation	Country	NP	TC	MR	AAS
1	Bhaskar, S. M. M.	South Western Sydney Local Health District Executive Office, Liverpool Hospital Eastern Campus	Australia	3	248	931	58
2	Huskamp, H. A.	Harvard Medical School, Boston	United States	3	313	587	323
	Mehrotra, A.	Harvard Medical School, Boston	United States	3	313	587	323
	Uscher-Pines, L.	RAND Corporation, Santa Monica	United States	3	313	587	323
3	Chen, J.	NYU Grossman School of Medicine, New York	United States	2	810	1464	370
	Chunara, R.	New York University, New York	United States	2	810	1464	370
	Mann, D. M.	NYU Langone Health, New York	United States	2	810	1464	370
	Nov, O.	New York University, New York	United States	2	810	1464	370
	Testa, P. A.	NYU Langone Health, New York	United States	2	810	1464	370
4	Deleener, M. E.	Penn Medicine, Philadelphia	United States	2	392	669	489
5	Ganguli, I.	Harvard Medical School, Boston	United States	2	312	341	273
6	Rodriguez, J. A.	Harvard Medical School, Boston	United States	2	255	421	55
7	Barnett, M. L.	Brigham and Women's Hospital, Boston	United States	2	254	385	306
8	Tenforde, A. S.	Harvard Medical School, Boston	United States	2	188	641	13
	Borgstrom, H.	Spaulding Rehabilitation Hospital Network, Boston	United States	2	188	641	13
9	Banach, M. P.	Lipid and Blood Pressure Meta-Analysis Collaboration (LBPMC) Group	Poland	2	165	564	42
	Bradley, S. A.	UNSW Medicine, Kensington	Australia	2	165	564	42
	Chattu, V. K.	University of Toronto, Toronto	Canada	2	165	564	42
	Moguilner, S.	Universidad Adolfo Ibáñez, Santiago	Chile	2	165	564	42
	Pandya, S.	University of Alberta, Edmonton	Canada	2	165	564	42
	Ray, D.	InfoUniversity College London Hospitals NHS Foundation Trust, London	United Kingdom	2	165	564	42
	Sakhamuri, S.	Medical Associates Hospital, Trinidad	United States	2	165	564	42
	Schroeder, S.	Pandemic Health System REsilience PROGRAM (REPROGRAM) Consortium, Sydney	Australia	2	165	564	42
10	Silver, J. K.	Harvard Medical School, Boston	United States	2	154	658	21
11	Vaishya, R.	Indraprastha Apollo Hospitals, New Delhi	India	2	142	500	13
12	Raja, P. V.	The Ohio State University, Columbus	United States	2	141	421	66
	Sousa, J. L.	RAND Corporation, Santa Monica	United States	2	141	421	66

Table 3. Most prolific researchers. The research listis ranked based on the number of publications and total citations received against their publications. Notes: NP = No. of publication, TC = Total citations, MR = Mendeley Readers, AAS = Altmetric Attention Score.

4.3. Most prolific countries

40 countries contributed the top 100 highly cited articles. Table 4 illustrates the top 10 most prolific countries that contributed their research to the top 100 highly cited papers on mHealth during the COVID-19 pandemic. Undoubtedly, the United States was the leading contributor in the field (NP=55, TC=5432, AAS, 4658), followed by the United Kingdom (NP=10, TC=830, AAS=394), etc. Previous analysis also reported that the United States was the most productive country in this field, with the most significant number of publications (Cao *et al.,* 2021; El-Sherif *et al.,* 2022). Countries like the United States and the United Kingdom are consistently identified as the most prolific in mHealth research (Sweileh *et al.,* 2017; Wu *et al.,* 2022). The reason may be due to the boasts of a robust and innovative healthcare ecosystem comprising world-class research institutions, renowned universities, and cutting-edge technology companies. Other high-income countries such as the United Kingdom, Canada, Italy, Spain, and Australia are also identified as significant contributors to mHealth research. In some studies, China is a major contributor to mHealth research (Sweileh *et al.,* 2017; Tapera & Singh, 2021), while India is also a significant contributor. However, high-income countries such as the United States and European nations are more prominent in this field. Developing countries have the potential to contribute more to mHealth research and improve health services through technology.

Rank	Country / Territory	NP	TC	AAS
1	United States	55	5432	4658
2	United Kingdom	10	830	394
3	Canada	9	727	511
4	Italy	7	484	69
5	Spain	6	388	122
6	Australia	5	550	443
7	India	5	407	43
8	China	4	247	387
9	Germany	4	237	24
10	Malaysia	4	153	34

Table 4. Most prolific countries of mHealth research. The countries are ranked based on the number of publications and total citations. Notes: NP = No. of publication, TC = Total citation, AAS = Altmetric Attention Score.

4.4. Dissemination pattern of research highlights through social webs

Table 5 presents the dissemination pattern of research highlights on mHealth during the COVID-19 pandemic through various social media, mass media, and reference manager platforms. The result shows that eleven social web platforms, including reference manager (Mendeley), played a significant role in disseminating research highlights during the pandemic. As seen in the table, the micro-blogging social media platform Twitter played an important role in the research information dissemination of mHealth. Mass media channels played an essential role in information dissemination during the pandemic. The research highlights on mHealth research were also mentioned in the various mass media channels/websites. It signifies the pattern of accurate information dissemination and awareness of the disease outbreak through mass media. Twitter is the leading social media platform for disseminating research highlights on mHealth research during COVID-19 due to its potential for real-time public health monitoring (Vidal-Alaball *et al.,* 2019). Apart from that, several previous studies also found that Twitter is the primary channel to disseminate the research highlights (Thelwall *et al.,* 2013; Parrish *et al.,* 2020; Kolahi *et al.,* 2020; Shamsi, Lund & Seyyed Hosseini, 2022; Nabavi, 2022; Basumatary *et al.,* 2022; Borcak & Bulut, 2023). During the COVID-19 pandemic, Twitter experienced a 23% increase in daily use compared to the previous period, making it an effective tool for reflecting and predicting public opinion on different topics, including healthcare issues (Corti *et al.,* 2022). Therefore, Twitter is an effective platform for sharing research highlights on mHealth during COVID-19 with a broad audience. A total number of 2,195 tweets were associated with the 61 countries (Figure 2), where the most number of tweeters were related to the United States (n=750), United Kingdom (n=189), and Spain (n=105). However, 34.94% of tweets are tweeted from the unidentified geographical region. Twitter provides Application Programming Interfaces (APIs) that allow third-party services like Altmetric to retrieve public data and aggregated metrics related to content engagement. However, Twitter's API restrictions and privacy policies generally limit

the availability of specific user details, such as individual country information, to ensure user privacy and data protection. Therefore, when it comes to Altmetric's database, the country of tweeters of particular articlesis typically unknown because the platform needs direct access to or stores detailed geographical information about individual Twitter users. Instead of collecting and storing personal data, Altmetric tracks social media attention and the impact of scholarly publications.

Other social media platforms also seen that participated in the dissemination of research highlighting mHealth during the pandemic. Similarly, research on mHealth was shared/read significantly on the reference manager Mendeley due to its features that help researchers collect references, organize citations, and create bibliographies (Basumatary *et al.,* 2023). However, the articles could have attracted mention on Facebook, one of the most popular social media platforms with more than 2.9 billion monthly active users (Meta, 2023; Statista, 2023). The publications received an overall 7,384 altmetric attention score (AAS).

Year	NP	TC	Blogs	Wikipedia pages	Tweeters	Facebook pages	Patents	Video uploaders	Redditor	Policy source	Research highlight platform	News outlets	Mendeley	AAS
2020	71	6,844	38	8	1,533	24	4	2	2	24	1	484	20,749	5,029
2021	28	1,563	25	1	657	5	0	0	1	13	0	241	4,875	2,351
2022	1	52	0	0	5	0	0	0	0	0	0	0	198	4
TOTAL	**100**	**8,459**	**63**	**9**	**2,195**	**29**	**4**	**2**	**3**	**37**	**1**	**725**	**25,822**	**7,384**

Table 5. The dissemination pattern of research highlights through social media, mass media, and reference manager platforms. Notes: NP = No. of publications, TC = Total citations, AAS = Altmetric Attention Score.

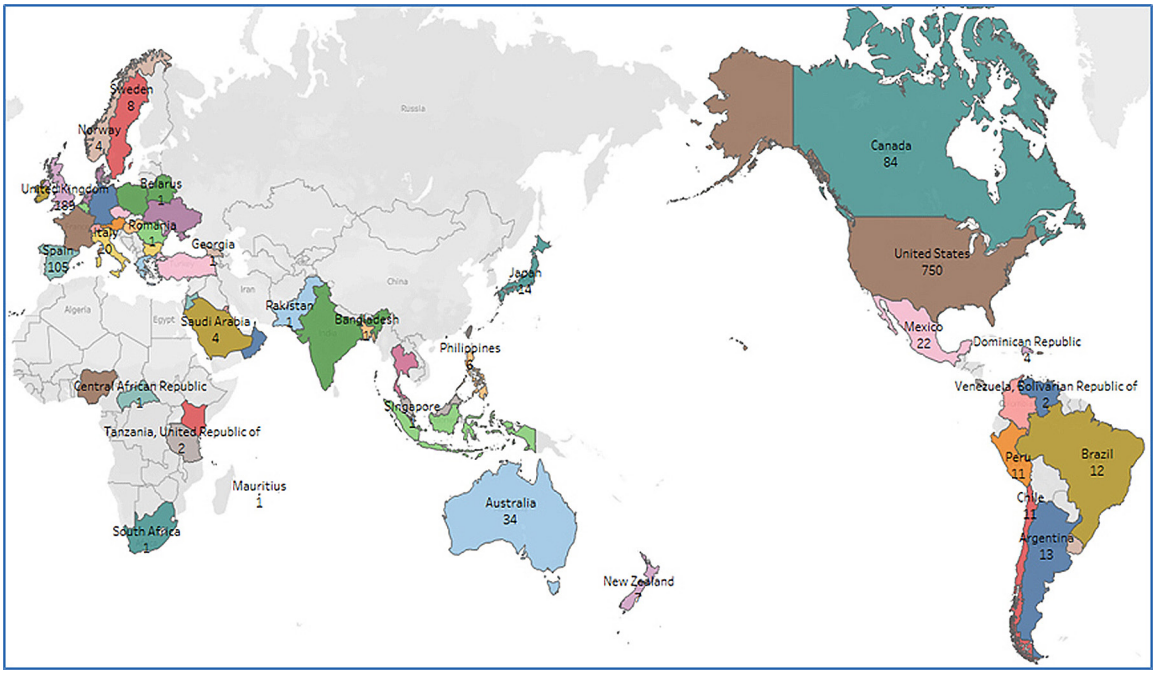

Figure 2. Geographical regions of tweeters regarding mHealth research.

4.5. Correlation analysis between citation and AAS

It is found that the correlation between Citation and AAS of the research publications on mHealth has a weak positive correlation (r=0.215, p=0.032). Table 6 illustrates the correlation range, and Figure 3 supplements the correlation between two variables with the scattered plot graph. A correlation coefficient indicates the extent to which dots in a scatter plot lie on a straight line. The figure below nicely illustrates that point (Basumatary *et al.,* 2023). It indicates that the changes in citations are correlated with changes in the AAS.

The co-relational analysis of citation count and Altmetric attention score for mHealth research provides insights into the relationship between traditional academic citations and the broader online attention received by research on mHealth. Academic citation counts and Altmetric attention scores correlate positively, suggesting that articles with more citations attract more online attention. A scholarly work recognized within an academic community also generates interest and discussion among a broader audience on social media platforms, news outlets, blogs, and other online platforms. The correlation analysis helps highlight the multidimensional impact and reach of mHealth research. While academic citations reflect the influence and importance of a publication within the scientific community, Altmetric attention scores capture the extent of its engagement and dissemination in the wider online sphere. This correlation suggests that impactful research in the mHealth domain not only contributes to the academic literature but also has the potential to resonate with a broader audience and influence public discourse.

		Citation	AAS
Citation	Pearson Correlation	1	0.215*
	Sig. (2-tailed)		0.032
	N	100	100
AAS	Pearson Correlation	0.215*	1
	Sig. (2-tailed)	0.032	
	N	100	100

* Correlation is significant at the 0.05 level (2-tailed).

Table 6. Co-relation between citation and AAS of the research publications on mHealth during COVID-19.

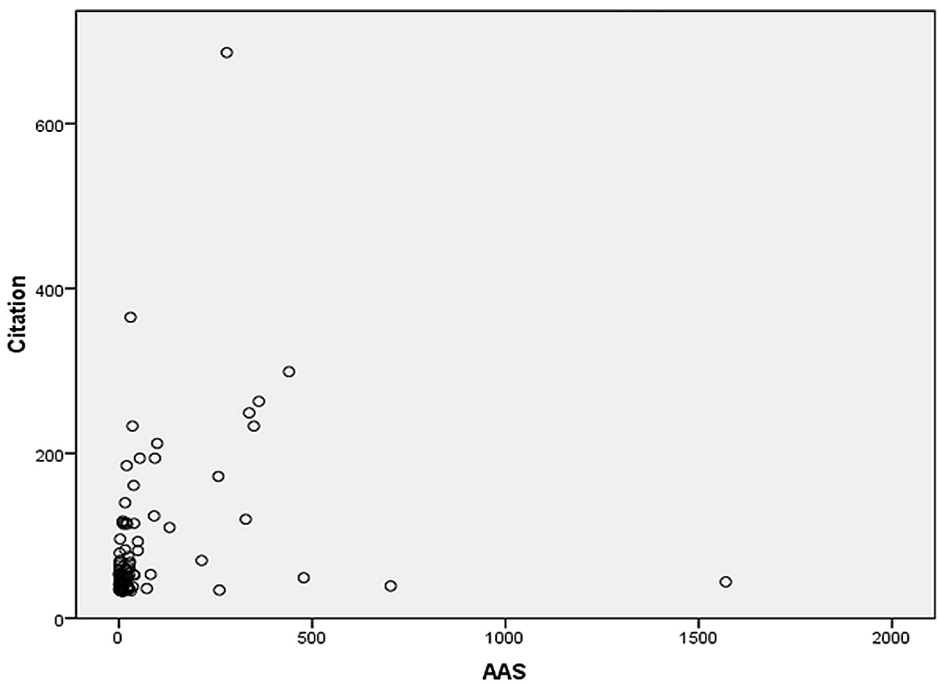

Figure 3. Correlation scattered plot of citation and AAS. A correlation coefficient indicates the extent to which dots in a scatter plot lie on a straight line. The figure nicely illustrates that citation and AAS have a weak positive correlation.

5. CONCLUSION

This study examined the social attention to the scientific publications in the field of mHealth during the unprecedented health crisis, i.e., the COVID-19 pandemic using altmetric tools. The research findings demonstrate a significant surge in social attention toward mHealth publications. The analysis revealed that mHealth publications related to COVID-19 attracted considerable attention across various social media, mass media, reference managers, and other social web platforms. This highlights the increasing significance of these platforms as avenues for scientific communication and knowledge dissemination, particularly during global crises. Moreover, the study identified the key scientific players in the field who actively participated in the research activities. However, compared to the users' engagement in social media platforms, the dissemination and interaction with research publications on such topics need to be improved. Researchers, publishers, and concerned organizations affiliated with can participate in the research promotion activities through various social media platforms. The promotion of research after publication is crucial to reach mass audiences. Sharing the highlights of a research paper through social media can bridge the gap between academia and society, enhancing the diffusion of information (Verma & Yuvaraj, 2022; Basumatary *et al.,* 2022; Basumatary *et al.,* 2023).

By analyzing social media engagement and online discussions surrounding mHealth publications, researchers and policymakers can gain a more holistic understanding of the reach and influence of their work. This valuable information can aid in shaping future research agendas, promoting public engagement, and facilitating evidence-based decision-making. As the world grapples with various health challenges, integrating mobile health solutions holds tremendous potential for improving healthcare delivery, patient engagement, and health outcomes. However, the study was limited to the 100 highly cited articles indexed on the Scopus database. Future studies can be carried out using comprehensive data and other databases like Web of Science, PubMed, Google Scholar, Dimensions, etc., that may provide different results.

Contribution statement

Literature search, literature review, data collection, data analysis, tabulation, and graphical presentation of data and manuscript draft preparation: Bwsrang Basumatary

Introduction, manuscript editing, and referencing: Sumeer Gul

Conceptualization of the ideas, research design, manuscript review, revision, and overall supervision: Manoj Kumar Verma.

Conflict of interest

The authors declare no potential conflict of interest in this research.

Statement of data consent

The data collected for this study has been included in the manuscript. ●

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