Original Research Article

Saudi scientific contribution toCovid-19 published research

ABSTRACT

Background: Credible scientific information plays a key role in thecontrol of epidemics and pandemics.

Objectives: To determine the contribution of Saudi published research in Covid-19 scientific information as regards topics, study types, institutional and geographical distribution of Covid-19 research publications.

Methods: In this descriptive study, we conducted aliterature search in Pubmed and Google Scholar by using the search terms: “Covid-19” OR “SARS-COV-2’’And “Saudi”. Abstracts of the articles were reviewed to identify relevant articles, and the data wereanalyzed using Epi Info statistical package.

Results: Out of the total 1,322 publications, 641 (48%) were reviewarticles, 410 (31%) wereoriginal research articles and195 (15%) were record-based clinical articles. Cross-sectional surveys comprised 84.6% of the original research; 57.9% of these surveys were conducted among thegeneral population while 42.1% wereamong healthcare professionals. The highest proportion of publications wasfrom universities (71%) and Riyadh (40.4%) province. The articles were published in 586 journals; among these 23 (3.9%) were Saudi journals.

Conclusion: Saudi researchers have made asignificant contribution to COVID-19 publications. However, ascarcity of analytical and experimental studies was observed. Researchers need to focus on these study designs to better guide clinicians and policymakers for evidence-based guidelines and policies in the local context.

Keywords:*COVID-19; database searching; health care surveys; journals; pandemic; PubMed; research design; SARS-Cov2*

1. INTRODUCTION

Credible scientific information plays a key role in thecontrol of outbreaks, epidemics, and pandemics. With limited and rapidly changing information about an epidemic or pandemic, needs assessment and planning mainly depend on timely research. An immediate collection and dissemination of quality information arespecifically important in thecase of newly emerging diseases to create awareness among the general population and to provide information to health care providers and policymakers for management and control of the emerging disease [1]. Moreover, research activities are vital for identifying the cause, designing preventive and control measures, and for developing specific drugs [2],[3].

In 2020, COVID-19 emerged as a pandemic and a global public health problem. Being a new disease, scientific information was needed on all aspects of COVID-19 including clinical features, pathogenesis, and possible regimens for treatment and prevention. Moreover, it was also important to explore the perceptions and level of awareness regarding COVID-19, among thegeneral population as well as health care workers. Realizing the importance of timely scientific information, COVID-19 became the main focus of research for medical institutions as well as researchers, and thousands of scientific articles, addressing various aspects of COVID-19, have been published as of now [4]-[8]. Researchers from various disciplines including clinicians, public health professionals, sociologists, psychologists, statisticians, and pharmacists contributed to COVID-19 research [9]. It is stated that in the history of scientific publishing such a great volume of research focused on a single topic has never been produced in a short period [10]. It is important and informative to review the published research to determine itscontents as well as geographical distribution.

Various forms of scientific communications for COVID-19 were reported including research articles, letters to the editor, editorials, and review papers [11]. Similarly, a variety of topics were addressed by researchers including epidemiology, pathogenesis, clinical features, treatment, prevention, and control of COVID-19. To explore the whole spectrum of COVID-19, it is important to conduct research with a variety of study designs. Observational studies regarding COVID-19 help determine the incidence, prevalence, risk factors, and clinical features of the disease while interventional studies can guide important treatment, control, and prevention strategies.

To determine the status of published COVID-19 research, several studies addressing the bibliometric aspects, such as countries, institutions, authors, and journals, have been published [1],[4],[12]-[15]. Other studies have looked into the publications from different perspectives, such as the topics of research and study designs [11],[16]-[23].

Countries around the world must strive to conduct quality research on COVID-19 to completely understand all aspects of the disease locally and globally. Research, that determines various aspects of disease within the local context, is necessary to manage and control the disease locally [5].

The first case of COVID-19 in Saudi Arabia was reported in March 2020. More than 800,000 cases have been reported as of now [24]. Like other countries in the world, researchers from Saudi Arabia conducted research on COVID-19 to explore various aspects of the disease in the local context, and also to determine the perception and response of the local community regarding COVID-19. However, in theliterature review, we were not able to find any study reviewing and summarizing COVID-19 research conducted in Saudi Arabia. Therefore, this study is designed to explore the characteristics of published COVID-19 scientific communications from Saudi Arabia. It is documented that for a pandemic, the research interest is greatest during its first year [25]. Thus, the current study focused on the COVID-19 scientific contribution from Saudi Arabia during the first year of the pandemic. The purpose of this study was to analyze quantitatively the Covid-19 scientific communication from Saudi Arabia, published in international journals and documented in PubMed and Google Scholar; to determine the topics related to Covid-19 addressed by researchers in Saudi Arabia; to determine the distribution of Covid-19 research publications in Saudi Arabia according to provinces and institutions; and to identify the gaps regarding Covid-19- related topics which are not taken up by researchers in Saudi Arabia. This study will help to identify potential gaps in the Saudi COVID-19 research which in turn guides the directions for future research.

2. METHODS

This was a descriptive study to explore salient features of COVID-19 scientific communications from Saudi Arabia. For retrieving published material, we conducted literature searches in two electronic databases: Pubmed and Google Scholar.

PubMed is freely available and is awidely used database for thesearch and retrieval of medical literature. It is a repository containing more than 31 million records of biomedical literature [26], [27]. Google Scholar search engine is also commonly used for searching scholarly literature. For a specific search term, Google Scholar is reported to return twice as many relevant articles as compared to PubMed [27]. Furthermore, Google Scholar searches can retrieve information from a variety of sources including publishers' websites, databases, and institutional repositories [28], [29]. Therefore, using a combination of Google Scholar and PubMed is recommended to retrieve awide range of medical literature [29].

We used the search terms: "Covid-19" OR “SARS-COV-2”And "Saudi" for our search. Broad search terms such as "Covid-19" OR “SARS-COV-2”were used to include as many relevant articles as possible. To retrieve the articles published from Saudi Arabia, we used 'Saudi' as a keyword. APubmed search was conducted from June 2020 to October 2021, and all relevant articles were included in the study. To broaden our literature search for the articles published during the first year of the pandemic (2020), we conducted the literature search on Google Scholar by using the filter for theyear 2019-2020.

All scientific publications identified within PubMed and Google Scholar were included in this study. Thus, original research, reviews, case reports and case series, editorials, letters to the editors, perspectives, commentary, and responses to articles, were included. The articles with thefirst author from an institution in Saudi Arabia or the second author from Saudi Arabia (if the study was conducted in Saudi Arabia) were included. The research conducted within Saudi Arabia was included even if the authors were not from institutions within the country. The articles were excluded if the first author was from an institution in Saudi Arabia,

but the study was conducted in another country. The review article with thefirst author outside Saudi Arabia but second/subsequent authors from Saudi Arabia were also excluded. Furthermore, we excluded the articles published in languages other than English.

The title of the articles and corresponding abstracts were reviewed for identifying published material from Saudi Arabia, and the information was saved in anExcel worksheet. A tabulatedlist of the published material was prepared including information about article title, author name, theinstitution of thefirst author, type of institution, geographical location of the institution, month of publication, and journal name. Furthermore, information about the published article including the main domain, study design, and the topic/subject addressed by the article was also extracted.

The variables for this study were defined as follows:

2.1 First author's institution group

The institutions of the authors were grouped into universities, theMinistry of Health, international institutions, and other institutions in Saudi Arabia. For the research conducted in Saudi Arabia with the author's location outside Saudi Arabia, the institution was classified as an'International institution'.

2.2Classification of scientific communications

Scientific communications were classified into four main domains including original research, record-based clinical articles, reviews, and others. The group 'reviews' included all scientific communications utilizing secondary data/information. Thus, in addition to narrative and systematic reviews, this domain included clinical guidelines/ recommendations, editorials, letters to the editors, perspectives, commentary, and responses to articles. Record-based clinical articles included all those articles for which secondary data from healthcare facilities or public health organizations were used including case reports, case series, and retrospective cohort studies. The main subjects of the articles were classified as prevention, guidelines/recommendations, clinical profile, diagnosis, epidemiology, pathogenesis, treatment, and others.

To match the requirement of our project, we used the classification of study designs utilized for literature reviews [30]. Because of a high volume of published surveys, they were further explored with regard to the category of participants and the topic addressed. The participants were classified into two main categories including thegeneral population and healthcare personnel, including students of various healthcare disciplines.

The data were transferred from anExcel worksheet and analyzed using thestatistical package Epi Info version 3.5.4. Frequencies and proportions of various variables were calculated.

3. RESULTS

During the period of our literature search, a total of 18,305 published articles were retrieved by using the keywords stated in the Methods section. After excluding articles not meeting the inclusion criteria and removing duplicate articles, a total of 1,322 articles were included in the study (Figure 1).

Fig. 1.Flow chart of article search and inclusion of Covid-19 Scientific Publications from Saudi Arabia

A total of 795 articles were retrieved for the year 2020 while 527 articles were retrieved for the year 2021. The first COVID-19 article from Saudi Arabia was published in February 2020, and publication output progressively showed an increase. During the year 2020, the number of articles increased from 3 in February to 106 in November. Out of the total 1,322 publications, 641 (48%) were review articles, 410 (31%) wereoriginal research articles and195 (15%) were record-based clinical articles (Figure 2).

Fig.2.Distribution of Covid-19 Publications according to Main Domains: Saudi Arabia

Table 1 details the distribution of study types of Covid 19 scientific publications from Saudi Arabia. A total of 631 (43.6%) scientific publications were review articles, letters to the editor, and editorials, followed by cross-sectional studies (n=556, 42.1%).

Table 1. Distribution of Covid-19 Scientific Publications according to study types: Saudi Arabia (n=1322)

Study Type	Frequency	Percentage
Review Article/Letter to the Editor/Editorial	631	47.7
Cross sectional studies (e.g., surveys and record reviews)	556	42.1
Case report/Case series/Case study	83	6.3
Meta-analysis	15	1.1
Cohort study	15	1.1
Case-control studies	9	0.7
Qualitative study	5	0.4
Study protocol	5	0.4
Clinical trials	3	0.2
Total	**1322**	**100**

Among the total 410 original research, 347 (84.6%) were cross-sectional surveys. Because of thesubstantial proportion of surveys and their peculiar nature, the surveys were separately analyzed regarding their target audience and the topic addressed. Among the remaining 975 publications, the most addressed topic was thetreatment of COVID-19 (n=186, 19.1%) followed by theepidemiology of COVID-19 (n=174, 17.8%) (Table 2).

Table 2. Distribution of Covid-19 Scientific Publications [Excluding surveys (n=347)] according to themain topic: Saudi Arabia

The topic of Scientific Publication	Frequency	Percentage
Treatment	186	19.1
Epidemiology	174	17.8
Clinical Profile	139	14.3
Guidelines/Recommendations	121	12.4
Prevention	77	7.9
Pathogenesis	69	7.1
Diagnosis	68	7.0
Others	141	14.5
Total	**975**	**100.0**

The surveys (n=347) were further analyzed. A total of 201 (57.9%) surveys were conducted among thegeneral population while 146 (42.1%) surveys had healthcare professionals (including students of various healthcare disciplines) as their participants. Almost half of the surveys (n=159, 45.8%) explored the impact of Covid 19 on themental, social, and educational aspects of the participants. Around one-third ofsurveys (n=116, 33.5%) addressed the knowledge, attitudes, beliefs, and practices of the participants regarding preventive measures forCOVID-19. The remaining20.7% ofsurveys were conducted on miscellaneous topics such as health and telemedicine; e-learning and online education; therole of social media, thewillingness of health care workers to work during COVID-19, and thewillingness of thegeneral public to undergo various medical procedures during COVID-19. The majorityof the surveys (81.8%) were conducted by universities while 9.2% (n=32) were done by theMinistry of Health, Saudi Arabia.

Figure 3 displays the distribution of articles according to institution groups. The highest proportion of publications wasfrom universities (n=945, 71%). The Ministry of Health institutions contributed 12% of the total scientific publications.

Fig.3.Distribution of Covid-19 Publications according to Institution Group: Saudi Arabia (n=1322)

On analyzing the distribution of publishing journals, it was found that the articles were published in 586 peer-reviewed journals. Out of the total 586 journals, 23 (3.9%) were national journals. Journal articles retrieved from Saudi journals, accounted for 14.1% (n=187) of the total articles.

The province with the highest number of publications was theRiyadh region, having 40.4% of all retrieved articles. Jeddah contributed 14.1% of the total articles followed by theEastern region (13.8%) and Makkah (4.7%) province (Table 3).

Table 3. Geographical Distribution of Covid-19 Publications: Saudi Arabia

Place	Frequency	Percentage
Riyadh	534	40.4
Jeddah	187	14.1
Eastern Region	182	13.8
Makkah	62	4.7
Asir	57	4.3
Qassim	56	4.2
Medinah	44	3.3
Jazan	41	3.1
Hail	35	2.6
Taif	31	2.3
Jouf	24	1.8
Najran	21	1.6
Al Ahsa	10	0.8
Tabuk	4	0.3
Baha	3	0.2
Al jouf	2	0.2

Northern Border	3	0.3
International	26	2.0
Total	**1322**	**100**

4. DISCUSSION

The importance of scientific literature to combat outbreaks and pandemics is undisputable, as it meets the needs of information for healthcare providers as well as decision-makers. As the COVID-19 pandemic progressed, a surge of scientific publications was observed. Being a new disease, it was important to share all available information about the disease to design interventions to control COVID-19. Globally, most countries made their efforts to explore this new disease scientifically [8]. However, it is important to assess the scientific publications of individual countries in terms of their volume, topics, and implications on health care. Also, it is important to identify thelack of studies in specific areas that would have been helpful if conducted in the local context. Therefore, the current study analyzed the COVID-19 publications from Saudi Arabia regarding their frequency, main domains, topics, study types, institutions, and geographical distribution.

The number of publications on any given topic reflects the importance of the topic, as well as the interest of theresearch community in that topic. In our study, we noticed aprogressive increase in the number of publications after thefirst COVID-19 article waspublished inSaudi Arabia in February 2020. A similarpattern of progressive increase in a number of publications has been reported by studies conducted in other parts of the world [1], [4], [7]. This rapid increase in the number of publications may be attributed to theavailability of electronic research databases and real time data thatcould be analyzed instantly to provide information regarding this novel disease.

Conducting areview of existing literature, and sharing experiences and opinions are valuable in the event of an emerging disease. In the current study, approximately half of the scientific publications included reviews, commentaries, opinions, and experiences. Similar to our findings, a study from Africa reported 48.6% of the publications in this domain includecommentary and perspectives [5]. Another study analyzing the global research on COVID-19 from January to May 2020 found reviews comprising approximately half of the scientific publications [11]. Similarly, around one-third of the scientific publications from Arab countries were found in this domain in a study conducted inMarch 2020 analyzing the COVID-19 publications during the initial days of thepandemic [31]. This dominance of reviews, commentaries, and opinions in the initial days of thepandemic can be explained by the fact that scarce data was available about the new disease and the scientific community tried to understand the disease by reviewing the literature and sharing their perspectives regarding COVID-19. In our study, original research comprised 31% of the total scientific publications. Varying proportions of original research are reported by different studies; 65.08% from Arab countries [31], 46.6% from Africa [5], 42.7% from India [32], and 38.9% from Iran [8].

Globally, researchers from various disciplines have contributed to exploring COVID-19 by addressing a variety of topics. Thus, professionals from computer sciences, data science, sociology and psychology among others have published their original work and perspectives on COVID-19 [9]. In our study, several topics were addressed by researchers from various disciplines. However, the most addressed topic was COVID-19 treatment (19.1%) followed by its epidemiology (17.8%), and clinical features (14.3%). A study conducted on publications from Arab countries found epidemiology, pharmacological research, and clinical features of COVID-19, as the main research areas addressed by researchers [31]. Other studies conducted during the initial days of the pandemic have also found asimilar pattern

[4], [8], [31]- [35]. In Africa, a quarter (25%) of the scientific publications in the early days of thepandemic addressed the topics related to the preparedness and response to the pandemic by the countries [5]. Impact on health and life of people as well as clinical features and transmission of COVID-19 were also commonly discussed topics found in this study. However, the authors noted a deficiency of clinical trials concerning treatment and vaccines [5]. Although treatment was the most common topic addressed in our study, most of the articles were review articles, theoretically discussing various treatment options. Original research for treatment and prevention in the local context isimportant to determine the most suitable therapeutic and preventive measures for the local population. Therefore, this gap needs to be filled by prioritizing research topics, accordingly.

In our study, the highest proportion of study type was literature reviews including review articles, letters to the editor, and editorials (47.7%) followed by cross-sectional studies (42.1%). It has been noted that during the first 16 weeks of thepandemic the bulk of scientific publications comprised of narrative reviews, expert opinions, and commentaries, followed by case reports and case series [7]. Liu et al. (2020) also found that most publications were expert opinions and editorials [36]. This can be attributed to thelack of availability of adequate data regarding COVID-19 during the early days of thepandemic. In the current study, only 3 clinical trials were noted. Other researchers have also reported apaucity of clinical trials [1], [5], [7]. Although randomized controlled trials are considered the gold standard for assessing new treatments and innovations in pharmacologic and non-pharmacologic treatment modalities, they require time, effort, and specialized expertise.

Observational studies including case reports, case series, and cross-sectional studies have a vital role at the beginning of a pandemic as they can provide valuable information about the clinical features, prognosis, and epidemiology of the disease. Also, they are comparatively quick and easy to conduct. In our study, a substantial proportion (84.6%) of the original research was surveys while a very small proportion of study types (1.8%) comprised case-control and cohort studies. Guleid et al. (2021) reported 108 (17.8%) surveys out of atotal of606 primary research articles from Africa [5]. Further research is needed to explore any change in thetype of studies with time and availability of more data regarding COVID-19 in Saudi Arabia.

Universities are considered the hub of research activities. Most of the biomedical publications are reported to be produced by medical universities or colleges [37],[38]. In our study, themajority (71%) of the publications were from universities. On the other hand, Lou et al.(2020) reported that out of 183 articles published from 14 January to 29 February 2020, the highest number [78 (42.6%)] were published from hospitals, followed byuniversities [64 (35%)] and the research institution [39 (21.3%)] [2]. In Saudi Arabia, the high proportion of COVID-19 research conducted by universities can be explained by the fact that generally, the universities have better expertise and resources to conduct research as compared to other institutions.

An important finding in our study was that the articles were published in a wide variety of peer-reviewed journals, and out of the total 586 journals, only 23 (3.9%) were national journals. This needs to be further explored why a very small proportion of articles were published in the national journals despite theavailability of numerous well-reputed, indexed, peer-reviewed medical journals in Saudi Arabia.

Exploring thegeographic distribution of scientific publications in a country gives an idea of scientific activities in various parts of that country. Our study found that the highest proportion (40.4%) of the published articles was from Riyadh province. Previous similar studies from Saudi Arabia have also found the highest number of scientific publications from

Riyadh [37],[39]-[41]. Riyadh, being the capital city, has numerous academic institutions, tertiary care and teaching hospitals, and the central offices of theMinistry of Health, leading to theavailability of facilities and expertise for conducting research. Moreover, Riyadh province also includes many other cities with large hospitals and academic institutions.

Our study has some limitations. First, we did not search all scientific databases. However, we searched two of the most commonly used databases to include maximum publications. Second, our study provides only quantitative analysis of COVID-19 scientific publications from Saudi Arabia and does not explore their quality or usefulness in healthcare practice. Third, we searched only for studies published in English, thus missing the articles published in theArabic language. Fourth, misclassification in research topics of the articles is expected as two or more topics seemed appropriate in some articles. However, despite the limitations of our study, we consider this study thefirst step for further in-depth analyses to determine the quality, usefulness, and gaps in COVID-19 research in Saudi Arabia.

5. CONCLUSION

Saudi researchers have made asignificant contribution to COVID-19 publications, and a variety of topics have been covered by them. The epidemiologyof COVID-19 and its treatment were commonly discussed topics. Most of the studies were conducted by universities. The majorityof the published articles were reviews and cross-sectional studies, including surveys and those based on the available records at health care facilities. There was ascarcity of analytical and experimental study designs, which are placed higher on the evidence pyramid as compared to cross-sectional studies. Based on the results of our study, we recommend planning and implementinganalytic and experimental studies to better guide clinicians and policymakers to manage the disease and designing evidence-based policies in the local context.

ETHICAL APPROVAL

Ethical approval was obtained from Qassim Regional Research Ethics Committee.

REFERENCES

1. Chahrour M, Assi S, Bejjani M, Nasrallah AA, Salhab H, Fares M, Khachfe HH. A Bibliometric Analysis of COVID-19 Research Activity: A Call for Increased Output. Cureus 2020; 12(3): e7357. https://doi.org/10.7759/cureus.7357

2. Lou J, Tian SJ, Niu SM, Kang XQ, Lian HX, Zhang LX, Zhang JJ. Coronavirus disease 2019: A bibliometric analysis and review. Eur Rev Med Pharmacol Sci 2020; 24(6): 3411–3421. https://doi.org/10.26355/eurrev_202003_20712

3. Malik AA, Butt NS, Bashir MA, Gilani SA. A scientometric analysis on coronaviruses research (1900-2020): Time for a continuous, cooperative and global approach. J InfectPublic Health 2021; 14(3): 311–319. https://doi.org/10.1016/j.jiph.2020.12.008

4. Dehghanbanadaki H, Seif F, Vahidi Y, Razi F, Hashemi E, Khoshmirsafa M, Aazami H. Bibliometric analysis of global scientific research on Coronavirus (COVID-19). Med J Islam Repub Iran 2020; 34: 51. https://doi.org/10.34171/mjiri.34.51

5. Guleid FH, Oyando R, Kabia E, Mumbi A, Akech S, Barasa E. A bibliometric analysis of COVID-19 research in Africa. BMJ Glob Health 2021; 6(5): e005690. https://doi.org/10.1136/bmjgh-2021-005690

6. Haghani M, Bliemer MCJ. Covid-19 pandemic and the unprecedented mobilisation of scholarly efforts prompted by a health crisis: Scientometric comparisons across SARS, MERS and 2019-nCoV literature. Scientometrics 2020; 125(3): 2695–2726. https://doi.org/10.1007/s11192-020-03706-z

7. Jones RC, Ho JC, Kearney H, Glibbery M, Levin DL, Kim J, Markovic S, Howden J, Amar M, Crowther MA. Evaluating Trends in COVID-19 Research Activity in Early 2020: The Creation and Utilization of a Novel Open-Access Database. Cureus 2020; 12(8): e9943. https://doi.org/10.7759/cureus.9943

8. Shamsi A, Mansourzadeh MJ, Ghazbani A, Khalagi K, Fahimfar N, Ostovar A. Contribution of Iran in COVID-19 studies: A bibliometrics analysis. J Diabetes MetabDisord 2020; 19(2): 1845–1854. https://doi.org/10.1007/s40200-020-00606-0

9. Arencibia-Jorge R, García-García L, Galbán-Rodríguez E, Carrillo-Calvet, H. The multidisciplinary nature of COVID-19 research. BioRxiv, 2020.11.23.394312. https://doi.org/10.1101/2020.11.23.394312

10. Odone A, Salvati S, Bellini L, Bucci D, Capraro M, Gaetti G, Amerio A, Signorelli C. The runaway science: A bibliometric analysis of the COVID-19 scientific literature. Acta Biomed 2020; 91(9-S): 34–39. https://doi.org/10.23750/abm.v91i9-S.10121

11. Pal JK. Visualizing the knowledge outburst in global research on COVID-19. Scientometrics 2021; 126(5): 4173–4193. https://doi.org/10.1007/s11192-021-03912-3

12. Darsono D, Rohmana JA, Busro B. Against COVID-19 Pandemic: Bibliometric Assessment of World Scholars' International Publications related to COVID-19. JurnalKomunikasiIlkatanSarjanaKomunikasi Indonesia,2020; 5(1), 75–89. https://doi.org/10.25008/jkiski.v5i1.356

13. Farooq RK, Rehman SU, Ashiq M, Siddique N, Ahmad S. Bibliometric analysis of coronavirus disease (COVID-19) literature published in Web of Science 2019–2020. J Family Community Med 2021; 28(1): 1–7. https://doi.org/10.4103/jfcm.JFCM_332_20

14. Felice FD, Polimeni A. Coronavirus Disease (COVID-19): A Machine Learning Bibliometric Analysis. In Vivo 2020; 34(3 suppl): 1613–1617. https://doi.org/10.21873/invivo.11951

15. Kambhampati SBS, Vaishya R, Vaish A. Unprecedented surge in publications related to COVID-19 in the first three months of pandemic: A bibliometric analytic report. J Clin Orthop Trauma 2020; 11(Suppl 3): S304–S306. https://doi.org/10.1016/j.jcot.2020.04.030

16. Aristovnik A, Ravšelj D, Umek L. A Bibliometric Analysis of COVID-19 across Science and Social Science Research Landscape. Sustainability 2020; 12(21): 9132. https://doi.org/10.3390/su12219132

17. Bonilla-Aldana DK, Quintero-Rada K, Montoya-Posada JP, Ramírez-Ocampo, S., Paniz-Mondolfi A, Rabaan AA, Sah R, Rodríguez-Morales AJ. SARS-CoV, MERS-CoV and

now the 2019-novel CoV: Have we investigated enough about coronaviruses? - A bibliometric analysis. Travel Med Infect Dis 2020; 33: 101566. https://doi.org/10.1016/j.tmaid.2020.101566

18. ElHawary H, Salimi A, Diab, N, Smith L. Bibliometric Analysis of Early COVID-19 Research: The Top 50 Cited Papers. Infect Dis (Auckl) 2020; 13: 1178633720962935. https://doi.org/10.1177/1178633720962935

19. Hamidah I, Sriyono S, Hudha MN. A Bibliometric Analysis of Covid-19 Research using VOSviewer. Indonesian Journal of Science and Technology 2020; 5(2), 209–216. https://doi.org/10.17509/ijost.v5i2.24522

20. Hossain MM. Current status of global research on novel coronavirus disease (Covid-19): A bibliometric analysis and knowledge mapping. 2020: https://f1000research.com/articles/9-374

21. Mohadab ME, Bouikhalene B, Safi S. Bibliometric method for mapping the state of the art of scientific production in Covid-19. Chaos Solitons Fractals 2020; 139: 110052. https://doi.org/10.1016/j.chaos.2020.110052

22. Oh J, Kim A. A bibliometric analysis of COVID-19 research published in nursing journals. Sci. Ed 2020; 118–124.

23. Zengul FD, Zengul AG, Mugavero MJ, Oner N, Ozaydin B, Delen D, Willig JH, Kennedy KC, Cimino J. A critical analysis of COVID-19 research literature: Text mining approach. Intell Based Med 2021; 5: 100036. https://doi.org/10.1016/j.ibmed.2021.100036

24. Ministry of Health. Saudi Arabia. Covid-19 Dashboard: Saudi Arabia. 2022: https://covid19.moh.gov.sa/

25. Hu Y, Chen, M, Wang Q, Zhu Y, Wang B, Li S, Xu Y, Zhang Y, Liu M, Wang Y, Hu Y, Liu J. From SARS to COVID-19: A bibliometric study on emerging infectious diseases with natural language processing technologies. 2020: https://www.researchsquare.com/article/rs-25354/v1 DOI: 10.21203/rs.3.rs-25354/v1.

26. National Library of Medicine. PubMed Overview. (n.d.): https://pubmed.ncbi.nlm.nih.gov/about/

27. Shariff SZ, Bejaimal SA, Sontrop JM, Iansavichus AV, Haynes RB, Weir MA, Garg AX. Retrieving Clinical Evidence: A Comparison of PubMed and Google Scholar for Quick Clinical Searches. J Med Internet Res 2013; 15(8): e164. https://doi.org/10.2196/jmir.2624

28. Antell K, Strothmann M, Xiaotian C, Kevin O'Kelly. Cross-Examining Google Scholar. Reference & User Services Quarterly 2013; 52: 279–282. https://doi:10.5860/rusq.52n4.279

29. Nourbakhsh E, Nugent R, Wang H, Cevik C, Nugent K. Medical literature searches: a comparison of PubMed and Google Scholar. Health Info Libr J 2012; 29(3): 214-222.

30. Georgia State University. Literature Reviews: Types of Clinical Study Designs. 2015: http://research.library.gsu.edu/c.php?g=115595&p=755213

31. Zyoud SH. The Arab region's contribution to global COVID-19 research: Bibliometric and visualization analysis. Global Health 2021; 17(1): 31. https://doi.org/10.1186/s12992-021-00690-8

32. Raju NV, Patil SB. Indian Publications on SARS-CoV-2: A bibliometric study of WHO COVID-19 database. Diabetes MetabSyndr 2020, 14(5): 1171–1178. https://doi.org/10.1016/j.dsx.2020.07.007

33. Deng Z, Chen J, Wang T. Bibliometric and Visualization Analysis of Human Coronaviruses: Prospects and Implications for COVID-19 Research. Front Cell Infect Microbiol 2020; 10: 581404. https://doi.org/10.3389/fcimb.2020.581404

34. Wang P, Tian D. Bibliometric analysis of global scientific research on COVID-19. J BiosafBiosecur 2021; 3(1): 4–9. https://doi.org/10.1016/j.jobb.2020.12.002

35. Zhang H, Shaw R. Identifying Research Trends and Gaps in the Context of COVID-19. Int J Environ Res Public Health 2020; 17(10): 3370. https://doi.org/10.3390/ijerph17103370

36. Liu N, Chee ML, Niu C, Pek PP, Siddiqui FJ, Ansah JP, Matchar DB, Lam SSW, Abdullah HR, Chan A, Malhotra R, Graves N, Koh MS, Yoon S, Ho AFW, Ting DSW, Low JGH, Ong MEH. Coronavirus disease 2019 (COVID-19): An evidence map of medical literature. BMC Med Res Methodol 2020; 20(1): 177. https://doi.org/10.1186/s12874-020-01059-y

37. Latif R. Medical and biomedical research productivity from the Kingdom of Saudi Arabia (2008-2012). J Family Community Med 2015; 22: 25. https://doi:10.4103/2230-8229.149583

38. Yaman H, Kara IH. An evaluation of articles in international peer-reviewed publications in Turkish family medicine. Med Sci Monit 2007; 13: SR24–27.

39. Al-Bishri J. Evaluation of biomedical research in Saudi Arabia. Saudi Med J 2013; 34:954–959.

40. Jahan S, Al-Saigul AM. Primary health care research in Saudi Arabia: A quantitative analysis. Int J Health Sci (Qassim) 2017; 11(2): 9.

41. Tadmouri GO, Tadmouri NB. Biomedical research in the Kingdom of Saudi Arabia (1982-2000). Saudi Med J 2002; 23: 20–24.