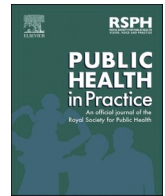




Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Oman's COVID-19 publication trends: A cross-sectional bibliometric study

Hasina Al Harthi ^a, Jehan Al Fannah ^b, Faryal Khamis ^c, Safaa Al Hashmi ^d, Badriya Al Syiabi ^d,
Abeer Al Habsi ^a, Abdallah Al-Maniri ^e, Qasem Al Salmi ^f, Salah Al Awaidy ^{g,*}

^a Research Unit, Royal Hospital, Ministry of Health, Oman

^b Department of Quality and Patient Safety, Royal Hospital, Oman

^c Department of Infectious Diseases, Royal Hospital, Ministry of Health, Oman

^d Medical Library, Royal Hospital, Ministry of Health, Oman

^e Oman Medical Specialty Board (OMSB), Oman

^f Director General, Royal Hospital, Ministry of Health, Oman

^g Health Affairs, Ministry of Health, Oman

ARTICLE INFO

Keywords:

Bibliometric analysis
Scientometric
COVID-19
Oman

ABSTRACT

Objective: Public health crises, such as the COVID-19 pandemic led researchers and clinicians to stretch their capacities in conducting, writing, reviewing, and publishing a wealth of pandemic-related research. Oman scholars, researchers, and clinicians are no different in their quest for rapid dissemination of relevant scientific knowledge, which is of paramount importance nationally and internationally. Given the intense international interest in COVID-19 research. The study aim is to describe the COVID-19 research output in Oman in relation to publication type, journal impact factor, collaboration, author affiliation and compared it with national scholarly output over the decade. **Study Design:** We carried out a bibliometric cross-sectional study. **Methods:** We included all Oman COVID-19 publications for the period February 14 and 25, February 2021. Data retrieved using search engines PubMed, Google Scholar and Directory of Open Access Journals. **Results:** The COVID-19 publications search generated 210 articles. There were 36.7% review articles and 30% original articles. Of note, 2.4% randomized controlled trials articles were produced during the search period, 1.4% systematic and meta-analysis articles. The 85.7% of the publications were in journals with defined impact factor (IF) and 89.4% of articles with IF < 5. There was 53.8% international collaboration. **Conclusion:** The need to increase research published in journals with high impact factors and there was a high international collaboration in reviews and report articles, which may require building national research capacity.

1. Introduction

The world is undergoing a flagrant health crisis that affects every sector and every country without exception [1]. In these times, access to the most credible scientific knowledge is essential to cope with the crisis. Academic journals and scholarly publishers are urged to make new knowledge openly available and to provide new insights promptly [2]. Scientists around the world have stepped into conduct experiments, observational studies and perform new analyses to obtain relevant information on the COVID-19 pandemic [3].

Health is a fundamental right of all people by the constitution of the World Health Organization (WHO) and the International Declaration of Human Rights [4]. In this perspective, health research is critical to generating new knowledge, developing policy, improving global health,

access, equity and economic progress. Strengthening research capacity is one of the most powerful, effective and sustainable ways to address national and international health issues [5].

It is widely recognized that scientific research has played a central role in the advancement of technology and health care in developing countries, however, developing countries have benefited only marginally from this situation [6,7]. Only 10% of global health research is devoted to conditions that account for 90% of the global disease burden, the so-called "10/90 health gap" [8]. Furthermore, the challenges of health research in developing countries are different from the developed world, which are also the cause of low scientific output from these countries. Only 2% of the scientific publications in indexed journals comes from developing countries [9]. One of the primary reasons for low-quantity and quality scientific research from the developing

* Corresponding author. P.O.Box 393 PC 100, Muscat, Oman.

E-mail address: salah.awaidy@gmail.com (S. Al Awaidy).

<https://doi.org/10.1016/j.puhip.2022.100310>

Received 7 June 2022; Received in revised form 25 July 2022; Accepted 16 August 2022

Available online 23 August 2022

2666-5352/© 2022 The Authors. Published by Elsevier Ltd on behalf of The Royal Society for Public Health. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

countries is the lack of research capacity [10]. Training and institutional development are key elements in research capacity strengthening [9, 10]. Many developing countries are striving to build their research capacity to solve their local health problems [10]. However, the opportunity for training and strengthening the research capacity remains low.

Healthcare services in the Gulf Cooperation Council (GCC) countries has witnessed significant growth [11]. This growth has been accompanied by the increased healthcare burden along with the scarcity of available evidence to support proper response to the emerging diseases and changing demography [12]. Therefore, it is crucial to generate and disseminate new knowledge to address health challenges in the region. Advancing health research agenda should become a national and institutional priority for countries in the region such as Oman. The known increase in COVID-19 pandemic research productivity worldwide, requires attention to bibliometric analysis of the local publication patterns to shed light on where we stand. Bibliometric studies or scientometric assessment has been utilized to assess the scientific output of different world regions in several scientific fields [12–14]. Noteworthy, GCC countries bibliometric indicators suggested general paucity in productivity and reduced visibility compared to other countries [12,15]. The collaboration and partnership between the developed and developing nations could provide multiple opportunities for research bridging the gap and resolving this inherent problem [16].

The Ministry of Health (MoH) in Oman, has founded a central committee to review and approve research from scientific and ethical aspects to ensure that researchers will come out with accurate and useful information relating to the health and service problems faced by the Omani society. The Committee contributes to advocacy of health research thus ensuring reliance on outcomes. This Committee is involved in identifying the common shortcomings of weak quality research proposals. On the other hand, it is also a tool for self-learning, as researchers will be briefed on how to improve the proposals for scientific research and how to obtain information. The central committee is responsible to review and approve multi-center or non-MoH collaboration, in addition to MSc and PhD graduation research proposals. Each directorate within the umbrella of MoH has its own research and ethics review committee responsible for research within the scope of that directorate and it feeds the central committee of research through an electronic website. All proposals and reviews are electronically governed by the MoH Center of Research and Studies.

The aim of this bibliometric study is to describe research publication trends related to the COVID-19 pandemic in Oman, assess the quality of these publications using impact factors, and analyze the type of collaboration.

2. Methods

The cross-sectional study included all Oman COVID-19 publications for the period February 14 and 25, February 2021. The dates reflect the time the authors collected the data as convenience sampling. Data was retrieved by two Librarians using the three search engines PubMed, Google Scholar and Directory of Open Access Journals. They cross checked the searches for accuracy using title, author (s)'s name and journal's name. The keywords used for search were "COVID-19" and "Oman". Abstracts were further screened by the (Authors: HA & JA) and article type, authorship institution, and topic area of the article was documented. The two authors (HA and JA) independently reviewed the titles and abstracts using the predetermined above inclusion/exclusion criteria and resolved disagreements through review and discussion until they reached consensus.

In addition, for comparative purposes indexed publications, scholarly output (Fig. 1) and international collaboration for Oman from 2010 to 2020 were exported from Scopus (Fig. 2). Furthermore, Scopus search was done on June 8, 2021 for top 10 journals, scholarly output metrics of Oman COVID-19 publications (Table 1).

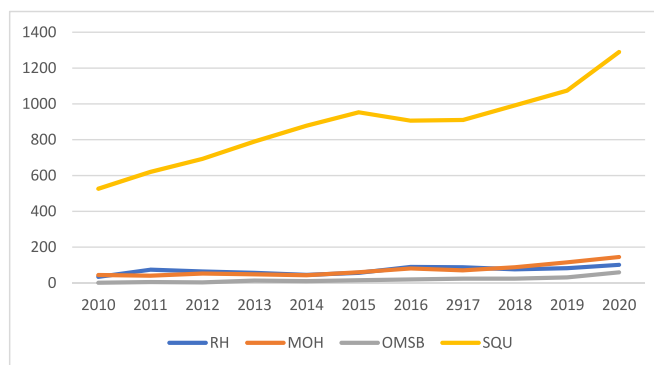


Fig. 1. Scholarly output in the last 10 years indexed in Scopus.

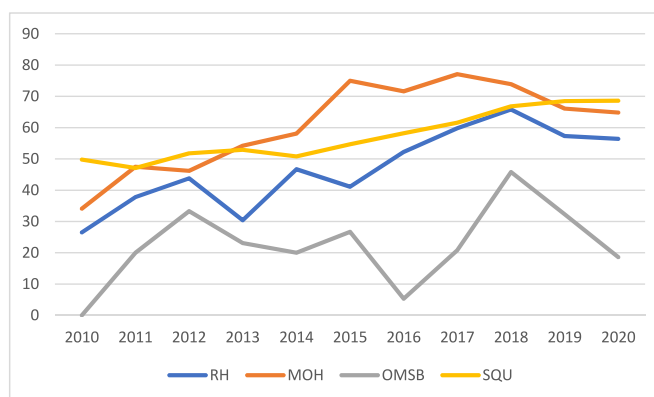


Fig. 2. Percentage of scholarly output through international collaboration trends in the last 10 years indexed in Scopus.

2.1. Article classification

Articles classified according to its type to: original article, case report/case series, clinical trials, reviews, systematic and metanalysis reviews, commentary, perspective, opinion, brief communication, editorial, letter to the editor. The article type was obtained by the highlight in the journal title or through screening of the article. Article content was classified to either medical and health science or other non-pure health articles. The latter was related to other disciplines including management, education, environment, and information technology.

2.2. Journal and impact factor

Journals were classified as national, regional (Middle East) or international, using journal name and publishing headquarters. The average or latest impact factor (IF) if within 2016–2020 was included in the analysis, otherwise we consider the journal without an IF.

2.3. Author(s) institution

Author's list reviewed to report institution of author if national and to indicate collaboration, collaboration is reported as none or a single institution if all authors belong to the same institution. National collaboration if they belong to more than one local institution and international if collaboration is with authors from non-national institutions. National institutions were classified to academic institutions, including Sultan Qaboos University Hospital (SQUH) and Oman Medical Specialty Board (OMSB), or to the Ministry of Health (MOH), and others which included non-MOH hospitals including private, governmental, and other institutions.

Table 1
Scholarly output metrics of Oman COVID-19 publications in the top 10 journals indexed in Scopus.

| Top Scopus Sources | | | | |
|--|------------------|-------------|--------------------------------|----------------|
| Entity: COVID-19 and Oman - 8 June 2021 - Year range: 2015 to 2021 - | | | | |
| Data source: Scopus, up to 02 Jun 2021 - | | | | |
| Scopus Sources | Scholarly Output | Views Count | Field-Weighted Citation Impact | Citation Count |
| Oman Medical Journal | 11 | 49 | 0.53 | 20 |
| International Journal of Infectious Diseases | 8 | 111 | 3.07 | 76 |
| Journal of primary care & community health | 3 | 29 | 0.36 | 1 |
| BMJ Open | 2 | 26 | 0.91 | 6 |
| International Journal of Advanced Computer Science and Applications | 2 | 14 | 0.00 | 0 |
| Mediterranean Journal of Hematology and Infectious Diseases | 2 | 25 | 1.61 | 15 |
| Sultan Qaboos University Medical Journal | 2 | 1 | 0.00 | 0 |
| 2nd Novel Intelligent and Leading Emerging Sciences Conference, NILES 2020 | 1 | 6 | 0.00 | 0 |
| Behaviour and Information Technology | 1 | 0 | 0.00 | 0 |
| Bio-Algorithms and Med-Systems | 1 | 6 | 0.00 | 0 |

| | |
|-----------|--|
| Metric 1: | Scholarly Output |
| | Types of publications included: all. |
| Metric 2: | Views Count |
| Metric 3: | Field-Weighted Citation Impact |
| | Types of publications included: all. |
| Metric 4: | Citation Count |
| | Types of publications included: all. Self-citations included: yes. |

2.4. Data analysis

All data analyses and visualizations were performed using the Statistical Package for Social Science (SPSS) Version 22 (IBM Corp. Chicago, Illinois, USA). Descriptive analysis in the form of frequencies, percentages, median and interquartile rations was calculated. Appropriate tables and graphs were designed to describe the study articles. Statistical inferences were drawn based on two tailed tests and the level of significance was set at $\alpha = 0.05$. The data were not normally distributed so non-parametric test Kruskal-Wallis H test was used to test the relation between IF an institution, collaboration, type of article and journal.

3. Results

3.1. Search results and publication type

A total of 210 articles retrieved and included during the search period. The commonest type of publications was review article 77 (37%) followed by original article 63 (30%). Twenty-four (11%) of the articles were commentary and brief communications. Case reports were 16 (7.6%), editorial were 11 (5%) and letter to editor were 11 (5%). Clinical trial publications were 5 (2%), systematic and meta-analysis reviews were 3 (1%) which were among the lowest publications (Table 2). Published articles in international journals were 165 (79%), in national journals were 26 (12%) and 18 (9%) in the regional journals (Table 2).

3.2. Quality of publication using impact factor (IF)

Only 180 (86%) of the publications (such as original articles, randomized controlled trials, reviews, letters or correspondence) were in journals with defined impact factor. Median IF found 2.25 (IQR: 1.28, 3.54). Maximum IF was 60.39 while the minimum was 0.1 and 89% of

Table 2
Publication characteristics.

| Variable | Number (n) | Percent (%) |
|---|------------|-------------|
| Area | | |
| Pure Health science | 143 | 68 |
| Other | 67 | 32 |
| Collaboration | | |
| Single institution | 73 | 35 |
| National collaboration | 24 | 11 |
| International collaboration | 113 | 54 |
| Publication type | | |
| Systematic review and meta-analysis | 3 | 1 |
| Original article | 63 | 30 |
| Case report/case series | 16 | 8 |
| Clinical trials | 5 | 2 |
| Reviews | 77 | 37 |
| Commentary, perspective, opinion, brief communication | 24 | 11 |
| Editorial | 11 | 5 |
| Letter to the editor | 11 | 5 |
| Journal | | |
| National | 26 | 12 |
| Regional | 18 | 9 |
| International | 165 | 79 |

articles with IF < 5. Four of the highest IF publication were with IF 60.39. Two of them were original articles (cross-sectional studies), one was a review article, and one was personal view. Both the review and the personal view were with international collaboration.

The articles with no defined IF were 30 (14.3%). Twelve (40%) were original articles and another 12 (40%) were reviewed. Only 6 (20%) were published in regional journals and the remaining were published in international journals.

Factors impacting IF were tested. No relation found between IF and

type of article with *p*-values of 0.34. However, publishing in international journals was associated with higher IF compared to national journals or regional journals with *p*-values <0.001.

The distribution of IF was found the same across national and international collaboration with *p*-value of 0.45. A significant difference was found between single versus national collaboration as well as single versus international collaboration with a *p*-value of 0.009 and 0.002 respectively overall *p*-value of 0.003. The distribution of IF of journals used to publish the national COVID-19 articles was found to be similar and insignificant across national and international collaboration with *p*-value of 0.45. A significant difference was found between single versus national collaboration as well as single versus international collaboration with a *p*-value of 0.009 and 0.002 respectively and overall *p*-value of 0.003. In relation to institutions, no significant difference found between MOH and academic institution (*p*-value 0.36) nor between Ministry of Health (MOH) and more than one institution category (*p*-value 0.21).

In relation to institutions, no significant difference found between MOH and academic institution (*p*-value 0.36) nor between MOH and more than one institution category (*p*-value 0.21). However, the difference was found between academic institution and other categories (*p*-values 0.009).

3.3. Type of collaboration

Single institution publications represented 73 (35%), collaboration at the national level 24 (11%) in which collaboration between academic and non-academic institutions were 8% (17/210). National collaboration was mainly between MOH and Sultan Qaboos University Hospital (SQUH). Collaboration was in 8 original articles and 4 clinical trials, the rest involved case report and reviews. One hundred and thirteen (54%) publications were with international collaboration. Around half of its 52 (46%) are reviewed, 33 (29%) original articles, one clinical trial and three case reports and case series. The remaining were commentary, opinion, brief communication, and editorials (Fig. 3).

4. Discussions

The ability to judge and evaluate a nation’s scientific publication is vital for healthcare institutions, the government and even for business ventures. Internationally, it was estimated that 4% of the world’s research output was devoted to the coronavirus in 2020, but 2020 also observed an exponential increase in publications on all subjects submitted to scientific journals, perhaps many researchers had to stay at home and focus on writing up papers rather than conducting science [17–19]. Bibliometric studies provide interesting methods for measuring the scientific value of a particular field over a specific time

[12–14].

Our study showed that international collaboration was associated with higher publishing in international journals and was associated with higher IF compared to national journals and regional journals with *p*-values <0.001. The impact factor is frequently used as an indicator of the importance of a journal to its field. Although IF is widely used by institutions and clinicians, people have widespread misconceptions regarding the method for calculating the journal IF, its significance and how it can be utilized. The impact factor is commonly used to evaluate the relative importance of a journal within its field and to measure the frequency with which the “average article” in a journal has been cited in a particular time. Journals which publish more review articles will get highest IFs. Journals with higher IFs are believed to be more important than those with lower ones [20].

The median IF found 2.25 (IQR: 1.28, 3.54) for the 180 articles with an impact factor was like the top ten rankings of journals publishing COVID-19-related publications from 22 Arab countries [21]. The average citation impact from publications from Oman is like the average citation impact for journal publication by other Arab countries [21].

This study showed that, international collaboration 113 (54%) was the highest collaboration, while single institution, publication was in 73 (35%) and national collaboration was at 24 (11%). Collaboration is now seen as essential to progress in scientific research, and over the past several decades, large-scale collaborative projects have become increasingly frequent in fields as diverse as medicine and healthcare [22]. Although these large collaborations have received more media attention, collaboration on a smaller scale is also important for scientific productivity. The possible effect of collaboration on improving scientific efficiency and productivity is particularly appealing. Governments and research institutions have been trying for many years to increase “research collaboration”, either to increase the advancement of knowledge or to increase the efficiency and effectiveness of research [22]. Additionally, inspired by the possible effects on scientific productivity and the expected benefits of encouraging collaboration, universities have developed research centers with this goal in mind. Nationally, the highest number of publications was linked to an academic institution.

Our study showed low national collaboration (11%) that is important for building national research capacity [22]. This requires navigating a diverse set of challenges, including a range of access barriers to effective research interventions and incentivize research publication under a developed research system [23]. The mutual dependence of researchers to broaden their knowledge and expertise is an essential element of successful research collaborations [23]. Furthermore, scholarly output over the last decade was the highest among academic institutions such SQUH, while international collaboration was similar between MOH and SQUH. In addition, it was observed that there was an international collaboration with case study related publication, which requires further research on what is the objective of international collaboration.

The way forward, is that academic and non-academic collaboration should be encouraged to help build capacity nationally and regionally. When comparing with a regional country [19] like Saudi-Arabia, which ranks first for the percentage number of COVID-19 publications at 35%, UAE at 11.73% (ranked 3rd) and Oman at 3.4% (ranked 10th) [19]. Oman should build partnership across the GCC countries especially a neighboring country like Saudi-Arabia which had the highest scholarly output in the region on COVID-19 publications. It has also been observed through this study, that collaboration was related to case studies and brief communication which means that collaboration may be related to language barriers and access to publication support. Furthermore, we selected COVID-19 articles over other topics to illustrate, though there has been a major increase in COVID-19 articles being a topic of top priority at a national and global level, the type of publications produced by national scholars are still tilted towards modest hierarchy of research design and moderate level of scientific evidence, as illustrated in our analysis in the publication type. This indicates the need for designing appropriate infrastructure and regulations for enhancing national

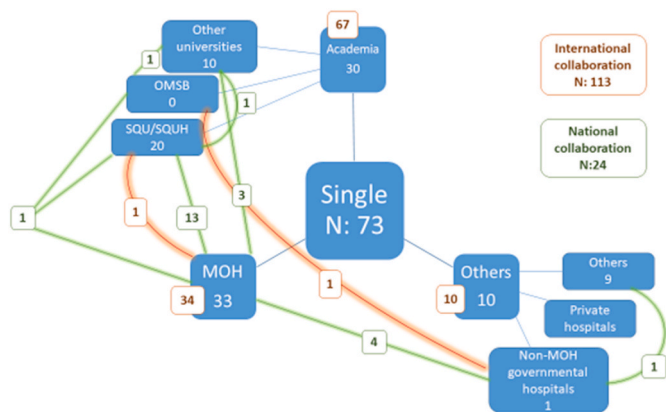


Fig. 3. Visualization map of distribution of COVID-19 publications among institutions.

research.

This bibliometric analysis shows the type and quality of research published on COVID-19 pandemic nationally. However, further research is needed to identify factors affecting research productivity and quality in national health care and academic institutions [24,25]. Intrinsic and extrinsic motivation factors for research productivity need to be defined within the national context. The extent of organizational support in accessing multidisciplinary teams, international research teams, funding, research management, and research technical support needs to be explored [25]. In addition, deeper investigation of collaboration and quality of publication is necessary for better understanding.

While bibliometric analysis of global scientific research on COVID-19 showed, that by April 2020 China ranked first in publication and the USA ranked second [26]. However, by June 2021 the USA ranked first and China ranked second in number of publications. The highest international collaboration was seen between the USA and China [27]. More than half of the publications were original articles [27].

5. Conclusions

This bibliometric analysis is an opportunity to trend research publication on COVID-19 pandemic, the quality of the publications and type of collaboration. Our bibliometric study showed high international collaboration but limited national collaboration and the analysis revealed international collaboration is associated with higher publications in high impact factor journals. This analysis reflects the overall type of COVID-19 publications from local scholars and highlights important areas for improvement such as increasing production, quality, applicability, and better research utilization. The study also demonstrated the need for more future work into potential obstacles and barriers to conduct research in Oman, such as capacity development. In addition, the study illustrated the need to review current practices by the Central Research Committee and to see how the level of research publication can be improved. It will be important to explore barriers to publishing research.

Ethical approval

Not required.

Funding

No sources of funding were used in the preparation of this manuscript.

Declaration of competing interest

The authors declare that they have no competing interests.

References

- [1] T.A. Hrynick, S.R. Lorenzo, S.E. Carter, COVID-19 response: mitigating negative impacts on other areas of health, *BMJ Global Health* 6 (4) (2021 Apr 1), e004110.
- [2] S.P. Horbach, Pandemic publishing: medical journals strongly speed up their publication process for COVID-19, *Quan. Sci. Stud.* 1 (3) (2020 Aug) 1056–1067.
- [3] A. Palayew, O. Norgaard, K. Safreed-Harmon, T.H. Andersen, L.N. Rasmussen, J. V. Lazarus, Pandemic publishing poses a new COVID-19 challenge, *Nat. Human Behav.* 4 (7) (2020 Jul) 666–669.
- [4] B. Toebe, The right to health as a human right in international law, *Refug. Surv. Q.* 20 (3) (2001 Jan 3).
- [5] M.M. Rahman, U.C. Ghoshal, K. Ragunath, G. Jenkins, M. Rahman, C. Edwards, M. Hasan, S.D. Taylor-Robinson, Biomedical research in developing countries: opportunities, methods, and challenges, *Indian J. Gastroenterol.* (2020 Jun 30), 1–1.
- [6] L. Dean, S. Gregorius, I. Bates, J. Pulford, Advancing the science of health research capacity strengthening in low-income and middle-income countries: a scoping review of the published literature, *BMJ Open* 7 (12) (2017 Dec 1), 2000–2016.
- [7] A. Yegros-Yegros, W. Van de Klippe, M.F. Abad-Garcia, I. Rafols, Exploring why global health needs are unmet by research efforts: the potential influences of geography, industry and publication incentives, *Health Res. Pol. Syst.* 18 (2020 Dec) 1–4.
- [8] O.P. Ottersen, J. Dasgupta, C. Blouin, P. Buss, V. Chongsuvivatwong, J. Frenk, S. Fukuda-Parr, B.P. Gawanas, R. Giacaman, J. Gyapong, J. Leaning, The political origins of health inequity: prospects for change, *Lancet* 383 (9917) (2014 Feb 15) 630–667.
- [9] M. Igoumenidis, S. Zyga, Healthcare research in developing countries: ethical issues, *Health Sci. J.* 5 (4) (2011 Oct 1) 243.
- [10] S.R. Franzen, C. Chandler, T. Lang, Health research capacity development in low and middle income countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature, *BMJ Open* 7 (1) (2017 Jan 1), e012332.
- [11] T. Khoja, S. Rawaf, W. Qidwai, D. Rawaf, K. Nanji, A. Hamad, Health care in Gulf Cooperation Council countries: a review of challenges and opportunities, *Cureus* 9 (8) (2017 Aug).
- [12] Al-Farsi YM, Albali NH, Alsaqabi MK, Sayed M, Al-Mawali AH, Al-Adawi S. Period-Prevalence and Publication Rate of Health Research Productivity in Seven Arabian Gulf Countries: Bibliometric Analysis from 1996 to 2018.
- [13] F.H. Guleid, R. Oyando, E. Kabia, A. Mumbi, S. Akech, E. Barasa, A bibliometric analysis of COVID-19 research in Africa, *BMJ Global Health* 6 (5) (2021 May 1), e005690.
- [14] I. Martynov, J. Klima-Frysch, J. Schoenberger, A scientometric analysis of neuroblastoma research, *BMC Cancer* 20 (2020 Dec), 1–0.
- [15] M. Ahmed, Bridging research and policy, *J. Int. Dev.* 17 (6) (2005 Aug 1) 765.
- [16] A. Älgå, O. Eriksson, M. Nordberg, Analysis of scientific publications during the early phase of the COVID-19 pandemic: topic modeling study, *J. Med. Internet Res.* 22 (11) (2020), e21559.
- [17] P.D. Sloane, S. Zimmerman, The impact of the COVID-19 pandemic on scientific publishing, *J. Am. Med. Dir. Assoc.* 22 (3) (2021 Mar 1) 484–488.
- [18] H. Else, How a torrent of COVID science changed research publishing-in seven charts, *Nature* 588 (7839) (2020 Dec 1) 553.
- [19] H.Z. Sa'ed, S.W. Al-Jabi, Mapping the situation of research on coronavirus disease-19 (COVID-19): a preliminary bibliometric analysis during the early stage of the outbreak, *BMC Infect. Dis.* 20 (1) (2020 Dec) 1–8.
- [20] M. Sharma, A. Sarin, P. Gupta, S. Sachdeva, A. Desai, Journal impact factor: its use, significance, and limitations, *World J. Nucl. Med.* 13 (2) (2014 May 1).
- [21] H.Z. Sa'ed, The Arab region's contribution to global COVID-19 research: bibliometric and visualization analysis, *Glob. Health* 17 (31) (2021 Mar), 1–0.
- [22] S. Kyvik, I. Reymert, Research collaboration in groups and networks: differences across academic fields, *Scientometrics* 113 (2) (2017 Nov) 951–967.
- [23] Y. Bu, Y. Ding, X. Liang, D.S. Murray, Understanding persistent scientific collaboration, *J. Assoc. Inform. Sci. Technol.* 69 (3) (2018 Mar) 438–448.
- [24] C.L. Ward, D. Shaw, D. Sprumont, O. Sankoh, M. Tanner, B. Elger, Good collaborative practice: reforming capacity building governance of international health research partnerships, *Glob. Health* 14 (1) (2018 Dec) 1–6.
- [25] J. Dusdal, J.J. Powell, Benefits, motivations, and challenges of international collaborative research: a sociology of science case study, *Sci. Publ. Pol.* (2021 Feb 15).
- [26] H. Dehghanbanadaki, F. Seif, Y. Vahidi, F. Razi, E. Hashemi, M. Khoshmirisafa, H. Aazami, Bibliometric analysis of global scientific research on Coronavirus (COVID-19), *Med. J. Islam. Repub. Iran* 34 (2020) 51.
- [27] P. Wang, D. Tian, Bibliometric analysis of global scientific research on COVID-19, *J. Biosafe. Biosecur.* 3 (1) (2021 Jun 1) 4–9.