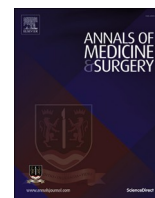




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Short Communication

## Bibliometric analysis of contributions to COVID-19 research in Malaysia

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## ARTICLE INFO

## Keywords:

COVID-19 publications  
Bibliometric analysis  
Malaysia  
Research outputs  
Active collaborator

## ABSTRACT

**Introduction:** The advent of COVID-19 has led to an exponential rise in related publications to provide a knowledge driven approach to tame the tide of infection and impact in all spheres. This study gives an insight into COVID-19 research publication pattern in Malaysia using bibliometric analysis.

**Method:** COVID-19 publications on Scopus database between January 1, 2020, and August 26, 2022, were extracted using predetermined search strings. Inclusion and exclusion criteria were set, and data was extracted from the database. Descriptive statistics was used to summarize our findings.

**Results:** A total of 3,553 COVID-19 related papers were retrieved out of global count of 392,613 and 16,466 for Southeast Asia (SEA). This implies that 0.9% and 21.6% is contributed globally and SEA respectively. Indonesia, Malaysia and Singapore are the three top countries with highest research outputs in the region. This may be correlated to high GDP per capita, research and development, and research and development expenditure. Most of the publications are article/original research (n = 2832, 67%). Ministry of Higher education is the top funding sponsor and Universiti Malaya is the highest contributor and the most cited (n = 466, 4920 citations). The majority of publications are from physical sciences (30.3%), but medicine subcategory produced the highest number of papers (1,586). The top journal was International Journal of Environmental and Public Health (n = 96 publications). Most active collaborating country was the United Kingdom and most active author was from Monash University.

**Conclusion:** Malaysian institutions have made profound contributions to COVID-19 research globally and in SEA. However, there is a need for continuous efforts to improve research outputs on the topic.

## 1. Introduction

COVID-19 became a global pandemic on March 11, 2020, after the declaration by World Health Organization due to its spread across nations and high infectious rate [1]. The disease is characterized by pneumonia-like symptoms of dry cough, fatigue, fever and lymphopenia [2]. A number of preventive measures: physical distancing, mask wearing in public, staying in ventilated places, hand hygiene and vaccination are put in place to mitigate the spread of infections. To date, more than 600 million and 6.48 million infections and deaths have been reported worldwide respectively [3]. In Malaysia, a number of cases more than 4.77 million are reported with more than 36,000 deaths, city of Selangor accounted for 1.64 million cases and 10,797 deaths out of this number [3].

The increasing number of infections and massive impact of the

pandemic have led to exponential rise in research outputs across nations among scientists around the globe, with Malaysia being a player in this [4]. Bibliometric study gives statistical overview of research trends in a particular area, research collaboration and citation analysis. It detects hotspots of research interests, generates information maps, as well as aids researchers in identifying research gaps [5]. The bibliometrics of 706 COVID-19 research in Southeast Asia gave a comparison of the trend of involvement of the eleven countries in the region. The comparison revealed that Malaysian, Singaporean, and Thai institutions and authors were responsible for the majority of the research outputs in the region [6].

In this study, we evaluate for the first time comprehensive bibliometric analysis of Malaysia's contribution to COVID-19 research using Scopus database since the outbreak of the disease.

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Received 29 August 2022; Received in revised form 30 September 2022; Accepted 30 October 2022

Available online 5 November 2022

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## 2. Methods and materials

The method adapted for this manuscript was similar to a recently published bibliometric analysis by Adebisi et al. [7]. For the purpose of this bibliometric study, the primary and only database that was searched was Scopus. When compared to the Web of Science, this database has over 23,000 more indexed journals from over 5,000 more publishers [8]. These journals cover all areas of scientific study. Since Scopus contains all the information found in Medline, it is clearly the superior resource [8,9]. The database provides two different ways to search for information: a basic approach and an advanced method. Both search methods permit the use of sophisticated and lengthy search queries to reach a high validity search result. One can search for phrases in a variety of locations on Scopus, including titles, titles/abstracts, journal names, author names, and affiliations, amongst other places. In fact, data from Scopus is used by both Times Higher Education and QS World Universities to design and apply their ranking systems for universities all over the world [10]. It is well-known that the Scopus database indexes publications from high-quality journals that have effective peer review mechanisms and editorial oversights. This contributes to the database's global credibility.

We construct the search query in order to do an advanced search within the Scopus database. The following search query was conceived up and utilized in the investigation: (*TITLE (covid-19 OR sars-cov-2 OR coronavirus OR 2019-ncov OR covid-19 OR coronavirus-19 OR "Coronavirusdisease" OR coronaviruses OR "COVID 19" OR covid19 OR 2019ncov OR "severe acute respiratory syndrome coronavirus 2" OR sarscov2 OR sarscov OR "Wuhan virus" OR "Wuhan coronavirus" OR "coronavirus" OR betacoronaviruses OR "coronavirusesinfections") AND AFFILCOUNTRY (malaysia) AND PUBYEAR > 2019 AND PUBYEAR < 2023.*

Any COVID-19 document indexed between January 1, 2020, and August 26, 2022, with at least one author affiliated with a Malaysian research institution, including universities, was eligible. There were no language restrictions, and all article types were included. Documents that did not match the inclusion criteria were excluded. Contributions from researchers of Malaysian origin who do not list a Malaysian affiliation on their COVID-19 article are not considered contributions from Malaysia. Y.A Adebisi extracted data from Scopus on August 26, 2022, and T.F Aroyewun and S.O Olaleye validated its accuracy. To ensure that the search queries matched the inclusion criteria, they were examined against the top 100 COVID-19 papers in Malaysia. This method was utilized to exclude potentially misleading data by deleting documents that were not about COVID-19 and do not have a Malaysian affiliation. The Scopus database data was transferred to Microsoft Excel. Bibliometric items, Scopus hierarchical classification, document types, active authors and institutions, journals, and funding agencies were all included in the exported data. Descriptive statistics were employed in analyzing the data.

## 3. Results and discussion

It is more than two years since the declaration of COVID-19 as pandemic. Between January 1, 2020, and August 26, 2022, a total number of COVID-19 related articles obtained by using the search query without specification of country's name were 392,613. This figure represents worldwide research outputs on COVID-19. Total contribution by the eleven SEA countries is 16,466. Malaysian's contribution to COVID-19 research is 0.9% and 21.6% globally and in Southeast Asia respectively. Indonesia, Malaysia and Singapore are the three highest scientific contributors in the region. Detail in Fig. 1.

The pandemic has prompted increased involvement of the region to mitigating the impact of the pandemic through research. The number of research from the three countries has increased more than ten folds from the earlier report by Ref. [6]. This may not be unconnected to a number of factors such as higher GDP per capita, research in R&D, physicians per

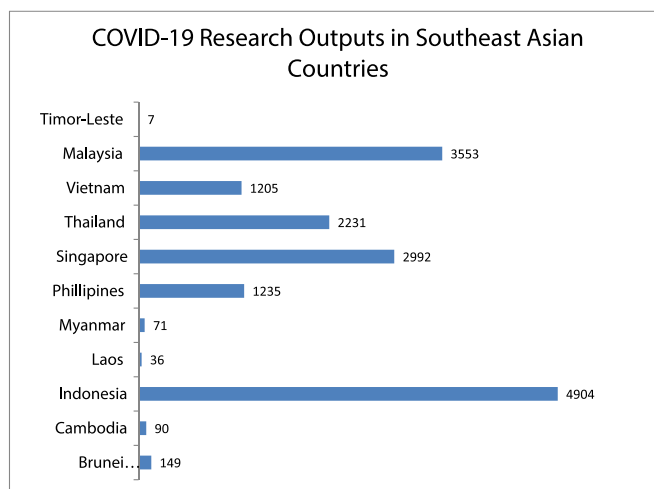


Fig. 1. COVID-19 research outputs in Southeast Asian countries (January 1st, 2020 to August 26th, 2022).

1000 population, number of international research collaborations and research & development expenditure [6]. Timor-Leste was a newly recognized country with three institutions that might have accounted for the low number of COVID-19 related articles ( $n = 7$ ) by the country.

From the total document of 3553, 2125 articles representing 59.8% had been cited at least fifteen times. Article/original research (67.0%) forms the majority of publications while book publication contributed 0.08% of the number which is the least. The Ministry of Higher Education, Malaysia funded 147 documents, with National Institutes of Health (NIH) funding 29 documents and National Natural Science Foundation of China (NSFC) funding 23 documents. Out of the top ten funding bodies, 8 of them were local bodies except NIH and NSFC that were international; 6 of the local bodies are institutions based in Malaysia. This shows strong research capacity by Malaysian university and heavy investment of Malaysian government to research and development. Detail in Table 1.

Based on distribution of COVID-19 related documents according to the Scopus hierarchical classification, most of the documents (30.3%) were in the field of physical sciences. Health sciences accounted for 29.3% of the documents, with medicine sub-category having 1586 documents in the group. It is expected that medicine sub-category will have the highest (25.5%) across all the sub-categories because it will be in the forefront in understanding disease progression and providing pharmaceutical solutions to tame the tide of pandemic. More work need to be done to tackle COVID-19 headlong through multidisciplinary approach, 2.0% of the total documents was placed as multidisciplinary. More details can be found in Table 2. Nine out of the ten research institutions in terms of contributions to COVID-19 research are Malaysian universities. University of Malaya, Universiti Sains Malaysia and Universiti Kebangsaan Malaysia occupy the first, second and third position with 466 documents (4,920 citations), 380 documents (3,065 citations) and 362 documents (3,942 citations) respectively. The only non-academic institution is Kementerian Kesihatan Malaysia with 169 publications and 894 citations. It is worthy to note that there may be correlation between funding bodies and the top 10 research institutions based on research output as seven funding sponsors made the list of the institution based on scientific contribution. More details are in Table 2.

Fig. 2 shows that Malaysian institutions have high collaboration between non-Malaysian countries. However, majority of the collaborations are with researchers outside SEA, most are from the UK ( $n = 461$ ), Australia (385) and India ( $n = 355$ ). Previous efforts revealed that nations with scientific collaboration (both local and international) tend to produce scientific publications with more impact than countries that close their doors to collaboration [11].

**Table 1**

A summary of scientific documents on COVID-19 research in all topic areas that have at least one Malaysian research institution affiliation (January 1st, 2020, to August 26th, 2022).

Database Summary	Total (January 1st, 2020, to August 26th, 2022)
Total documents	3,553
Total citations	30,995
Cited documents	2,125
Average citations	15
<b>Document Type</b>	<b>Number</b>
Article/original research	2,382 (67.0%)
Review	411 (11.6%)
Conference paper	294 (8.3%)
Letter	243 (6.8%)
Note	83 (2.3%)
Book chapter	55 (1.5%)
Editorial	48 (1.4%)
Erratum	13 (0.4%)
Data paper	11 (0.3%)
Short Survey	9 (0.2%)
Book	3 (0.08%)
Retracted	1 (0.03%)
<b>Top 10 Funding Sponsor</b>	<b>Number of Output Funded</b>
Ministry of Higher Education, Malaysia	147
Universiti Sains Malaysia	71
Universiti Kebangsaan Malaysia	63
Universiti Malaya	49
Kementerian Kesihatan Malaysia	41
Universiti Teknologi Malaysia	37
Universiti Teknologi MARA	36
National Institutes of Health	29
Universiti Putra Malaysia	26
National Natural Science Foundation of China	23

**Table 2**

Distribution of COVID-19 related documents according to the Scopus hierarchical classification and list of top 10 research institutions (January 1st, 2020, to August 26th, 2022).

Subject Area	Scopus Subject Area Classification (number of documents)
Physical Sciences (1882)	Computer Science (466); Engineering (400); Environmental Science (367); Mathematics (169); Physics and Astronomy (121); Energy (115); Chemistry (69); Material Science (68); Earth and Planetary Sciences (57); Chemical Engineering (50)
Health sciences (1820)	Medicine (1,586); Nursing (91); Health Professions (90); Dentistry (41); Veterinary (12)
Social Sciences and Humanities (1472)	Social Sciences (642); Business, Management and Accounting (285); Economics, Econometrics and Finance (195); Psychology (132); Decision Sciences (128); Arts and Humanities (90)
Life Sciences (909)	Biochemistry, Genetics and Molecular Biology (288); Immunology and Microbiology (237); Pharmacology, Toxicology and Pharmaceutics (224); Agricultural and Biological Sciences (108); Neuroscience (52)
Multidisciplinary (126)	-
<b>Top 10 Research Institutions Based on COVID-19 outputs</b>	<b>Number of publications (number of document citations)</b>
University of Malaya	466 (4,920)
Universiti Sains Malaysia	380 (3,065)
Universiti Kebangsaan Malaysia	362 (3,942)
Universiti Putra Malaysia	257(2409)
Universiti Teknologi MARA	223 (616)
Monash University Malaysia	200 (1300)
International Medical University	193 (1,385)
Kementerian Kesihatan Malaysia	169 (894)
Universiti Teknologi Malaysia	128 (966)
Universiti Malaysia Sabah	122 (726)

The top 10 journals that published COVID-19 research in Malaysia were shown in Table 3. The International Journal of Environmental Research and Public Health published the highest number of articles (96 publications). PLOS One and Medical Journal of Malaysia published 54 publications and 52 publications respectively. Only 30% of the journals are local, one of the local journals occupied the third position. A prior study showed that medical professionals perceived that publishing in foreign journals was more important than publishing in local journals. Their main reason is usually to reach wider readership coverage [12]. Kow, C.S, affiliated to Monash University Malaysia, Bandar Sunway, Malaysia has the highest number of publications (n = 112) among the first 8 active researchers in Malaysia. Haque, M and Ramachandram, D.S have 42 and 30 publications respectively.

#### 4. Limitations

The COVID-19 publications used in this study were only limited to those available in Scopus database from January 1, 2020, to August 26, 2022. We depended on high-quality data, reliable publication coverage and complete records in Scopus database. This analysis still reflected most of the relevant literature in COVID-19 research in Malaysia. Despite this limitation, this study still showed the research pattern, gaps and future directions in the field of topic in Malaysia.

#### 5. Conclusion

Malaysian institutions are active contributors to COVID-19 research in SEA. However, there is need to improve global research contribution in the field. Although, it is obvious from the study that Malaysian institutions have huge research capacity and government is investing in research and development, there is need for continuous efforts on this to foster the country's development map and knowledge driven approach to curb the dreadful pandemic.

#### Annals of medicine and surgery

The following information is required for submission. Please note that failure to respond to these questions/statements will mean your submission will be returned. If you have nothing to declare in any of these categories then this should be stated.

#### Ethical approval

Not Required.

#### Please state any sources of funding for your research

None.

#### Author contribution

All the authors contributed equally to this paper and approved it for publication.

#### Registration of research studies

- 1 Name of the registry: Not Applicable
- 2 Unique Identifying number or registration ID: Not Applicable
- 3 Hyperlink to your specific registration (must be publicly accessible and will be checked): Not Applicable

#### Guarantor

Yusuff Adebayo Adebisi.

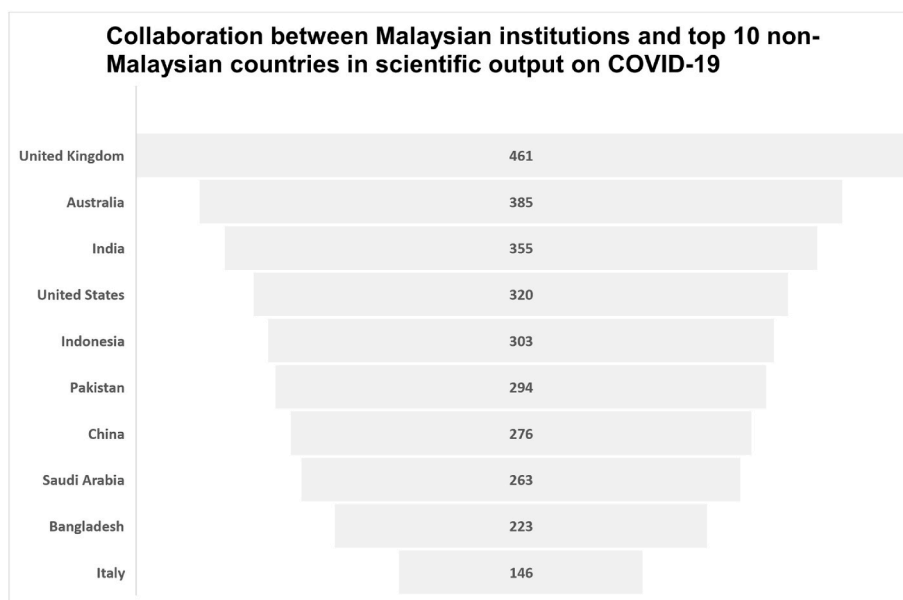


Fig. 2. Collaboration between Malaysian institutions and top 10 non-Malaysian countries in scientific output on COVID-19.

Table 3

Top 10 journals and top 8 active authors with at least a Malaysian research institution affiliation (January 1st, 2020, to August 26th, 2022).

Top 10 Journals where COVID-19 documents with at least a Malaysian research institution affiliation, from January 1st, 2020, to August 26th, 2022, were published.	Number of COVID-19 document published
International Journal of Environmental Research and Public Health	96
PLOS One	54
Medical Journal of Malaysia	52
Sustainability Switzerland	46
Frontiers In Public Health	44
Malaysian Journal of Medicine and Health Sciences	38
Asia Pacific Journal of Public Health	35
Frontiers In Psychology	35
Lecture Notes in Networks and Systems	31
Malaysian Journal of Medical Sciences	31
Top 8 active authors in COVID-19 papers in Malaysia (Rank)	
Kow, C.S. (1st)	112 (Monash University Malaysia, Bandar Sunway, Malaysia)
Haque, M. (2nd)	42 (National Defense University of Malaysia, Unit of Pharmacology, Kuala Lumpur, Malaysia)
Ramachandram, D.S. (3rd)	30 (Monash University Malaysia, School of Pharmacy, Bandar Sunway, Malaysia)
Alias, H. (4th)	26 (Universiti Malaya, Department of Social and Preventive Medicine, Kuala Lumpur, Malaysia)
Peariasamy, K.M. (5th)	22 (Kementerian Kesihatan Malaysia, Institute for Clinical Research, Putrajaya, Malaysia)
Wong, L.P. (5th)	22 (Universiti Malaya, Kuala Lumpur, Malaysia)
Chellappan, D.K. (6th)	21 (International Medical University, Kuala Lumpur, Malaysia)
Marzo, R.R. (7th)	20 (Monash University Malaysia, Bandar Sunway, Malaysia)
Jeffree, M.S. (8th)	18 (Universiti Malaysia Sabah, Kota Kinabalu, Malaysia)

Consent

Not required.

Declaration of competing interest

None.

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