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## LETTER TO EDITOR

### COVID-19: Global inequality in science

#### KEYWORDS

Bibliometrics;  
Inequality;  
Gini Index;  
COVID-19;  
Publications;  
Countries;  
Web of Science

#### Abbreviations

A&HCI	Arts & Humanities Citation Index
ASEAN	Association of Southeast Asian Nations
BRICS	Brazil, Russia, India, China and South Africa
COVID-19	coronavirus disease 2019
G7	Group of Seven (France, Germany, Italy, Japan, United States, United Kingdom, Canada)
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
SAARC	South Asian Association for Regional Cooperation
SCI-E	Science Citation Index-Expanded
SSCI	Social Science Citation Index
WHO	World Health Organization
WoS	Web of Science

#### Introduction

A country's progress in scientific research and technological innovation is measured by the number of papers and patents it produces each year [1]. Scientists responded quickly to the COVID-19 epidemic in terms of publications, publishing a huge number of papers for the first time [2]. According to the World Health Organization (WHO), coronavirus disease 2019 (COVID-19) had affected 281,808,270 people and caused 5,411,759 fatalities as of January 04, 2022. In terms of countries, the Gini coefficient for affected cases in 226 countries is 0.856, whereas the Gini coefficient for deaths in 214 countries is 0.862. Thus, an investigation of the imbalance in scientists' responses to the COVID-19 outbreak has been led.

The Gini coefficient is the most extensively used indicator of inequality [3]. Even though it was first used to measure income and wealth distribution [4,5], it is now being used

to measure inequality in publication output [6–8] as well as in citation distribution [9,10].

This is the first study to look into whether there is a disparity between countries that contributed to COVID-19-related research in terms of the number of publications.

#### Data and methods

We used Clarivate's Web of Science (WoS) Core Collections to find the papers linked to COVID-19 across all three indexes: Science Citation Index-Expanded (SCI-E), Social Science Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI). The following set of keywords has been used to search in the topic:

“COVID-19” OR “coronavirus disease 2019” OR “coronavirus 2019” OR “SARS-COV-2” OR “2019-nCov”

All the publications related to the above keywords have been considered without any limitations, such as vaccines, document type, language, subject area, geographical location, etc. On the date of search (January 04, 2022), there were 184,229 records on COVID-19 and analyse results tool of the Web of Science has been used to retrieve the data on contributing countries. Of the 184,229 records, 8,429 records (4.48%) do not contain the country information. Accordingly, the data has been downloaded in csv format and exported to MS-Excel for further analysis.

Country groupings were done manually. For example, the countries of England, Scotland, North Ireland and Wales were grouped into the United Kingdom. Similarly, countries with different spellings were also merged. For example, Bosnia and Herz merged with Bosnia Herceg, and Sint Maarten merged with St Martin. There are some variations in the countries' names between Web of Science and WHO. For example, South Korea and North Korea in Web of Science are denoted as the Republic of Korea and the Democratic People's Republic of Korea, respectively by WHO. Hence, the country names have been normalized.

Countries were grouped by income based on the World Bank data available at <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>: low income ( $\leq \$1045$ ), lower-middle income ( $\$1046 - \$4095$ ), upper-middle income ( $\$4096 - \$12695$ ) and high income ( $\geq \$12696$ ). Three countries (St Helena, Falkland Island and French Guiana) have been classified under “Not classified” since the World Bank did not provide the information for these countries. Similarly, the countries were grouped by region based on the World Health Organization data (<https://www.who.int/countries>). Further, some predominant groups (e.g. Brazil, Russia, India, China and South

**Table 1** Countries and inequality.

	# Countries	Publications				Gini	Leading Country <sup>a</sup>
		Share of 202	Min.	Max.	Mean		
<b>Productivity level</b>							
Low	99	49.00	1	80	22	0.51	Panama
Medium	53	26.24	87	595	243	0.35	Jordan
High	50	24.76	621	55266	4936	0.61	USA
<b>Income level</b>							
Low income	27	13.37	2	538	75	0.60	Ethiopia
Lower-Middle income	53	26.24	1	9294	468	0.84	India
Upper-Middle income	53	26.24	1	20898	884	0.85	China
Higher income	66	32.67	1	55266	2852	0.80	USA
Not classified	3	1.49	1	23	8	0.56	
<b>WHO Region</b>							
Africa	46	22.77	1	2194	140	0.76	South Africa
Americas	42	20.79	1	55266	1822	0.93	USA
Eastern Mediterranean	22	10.89	4	3739	737	0.65	Iran
Europe	58	28.71	1	23229	1832	0.78	UK
South-East Asia	12	5.94	2	9294	1224	0.76	India
Western Pacific	22	10.89	1	20898	1899	0.83	China
<b>Prominent country groups</b>							
ASEAN (the Association of Southeast Asian Nations)	10		20	2242	687	0.54	Singapore
BRICS (Brazil, Russia, India, China, South Africa)	5		1458	20898	7894	0.47	China
European Union	27		90	14543	2521	0.64	Italy
G7 (Group of Seven)	7		3772	55266	17664	0.45	USA
OECD (Organisation for Economic Co-operation and Development)	38		87	55266	4856	0.68	USA
OPEC (Organization of the Petroleum Exporting Countries)	13		2	3739	779	0.69	Iran
SAARC (South Asian Association for Regional Cooperation)	8		8	9294	1655	0.75	India
Global Governance Group (G3)	30		3	3893	529	0.67	Switzerland

<sup>a</sup> Leading country in terms of number of publications related to COVID-19.

Africa [BRICS], Organisation for Economic Co-operation and Development [OECD], Groupe of Seven [G7], etc.) have also been used.

The Gini coefficient is computed using the R Package. In general, a Gini value of 0 indicates that all countries publish an equal number of papers on COVID-19 (i.e., publications are evenly spread across countries), whereas a Gini value of 1 indicates that all papers produced by a single country.

## Results

The results have been presented in Table 1. The global COVID-19 research included authors from 202 countries, with a Gini value of 0.865, which seems that very few countries dominate the research.

### Productivity level

All the contributing countries were divided into three categories based on the number of publications and related rankings. By doing so, countries are ranked by the number of publications they have published, in ascending order.

Countries with similar numbers of publications have been given the same rank, while the most productive country has been given the number 149. The percentile rank is calculated by dividing a country's rank by 149. Accordingly, the countries are divided into three categories based on their percentile scores: low (0–0.33), medium (0.34–0.66) and high (0.67–1).

Of the 202 contributing countries, almost 50% of countries belong to the low productivity group, and the remaining countries are equally spread across medium and high productivity. The average number of publications is 22 for low productive countries, 243 (almost 11 times of low productivity) for medium productive countries, and 4936 (more than 20 times of medium productivity and 224 times of low productivity) for high productive countries. In the case of inequality, the medium productive country group has received the lowest Gini value, whereas the other two groups received more than 0.5, which denotes that the countries in the medium productive group have relatively equal contributions.

### Income level

The highest number ( $n = 66$ ) of countries are grouped under high-income economies while other two groups (lower-middle and upper-middle income economics) have 53 countries each. Only 13% of countries are grouped under low income economies, which has the highest-minimum number of publications ( $n = 2$ ) whereas it is one for all other groups. There is no difference in the Gini value except that low income economies and middle income economies groups received lower Gini values than the average of the data set. The average number of publications is 75 for low-income economies, 468 (6 times higher than low income economies) for lower-middle income economies, 884 (10 times higher than low income economies) for upper-middle income economies and 2852 (almost 40 times higher than low income economies) for high-income economies.

### Region

All the contributing countries are grouped under six regions, and most of the countries belong to Africa, the Americas and Europe. The Eastern Mediterranean and Western Pacific have equal contributors (i.e. countries), whereas South-east Asia has the lowest number of nations. The average number of publications is highest for the Western Pacific, followed closely by Europe and the Americas. Similarly, the Americas have the highest-maximum number of publications, whereas Africa has the lowest. In terms of equality, the Americas received a higher Gini value than the average of the data set, while all other regions received lower than the average. Among the regions, the Eastern Mediterranean region received the lowest Gini value.

### Prominent groups

The BRICS and G7 country groups have the lowest Gini values of less than 0.5, whereas all other groups have more than 0.5. The SAARC group has the highest Gini coefficient. The G3 group has the lowest average number of publications, whilst the G7 group has the highest. The G7 group has the highest minimum number of publications, while the Organization of the Petroleum Exporting Countries (OPEC) group has the lowest. In a similar vein, the G7 and OECD groups have the highest-maximum number of publications, while the Association of Southeast Asian Nations (ASEAN) group has the lowest.

### Conclusion

A total of 184,229 publications were contributed by 202 countries, with perfect inequality ( $Gini = 0.865$ ) between them, which is equal to the number of fatalities ( $Gini = 0.862$ ), but somewhat greater than the number of cases affected ( $Gini = 0.856$ ). With only 22 publications per country, nearly half of the countries fall into the low productivity group. When it comes to inequality, the medium productivity group has the lowest Gini coefficient, which is less than 0.4. The Americas had a higher Gini value than the average. The Gini coefficient for all the significant groups is lower than the average, especially two of them (BRICS and G7) having less than 0.5. In concluding remarks, the value of Gini shows that only a few countries dominate the research activities in COVID-19 related research. Since this is the first

of its kind, similar research could be conducted on other diseases such as cancer, hepatitis, dengue fever, zika virus, and so on.

There are a few limitations: (1) The study used the whole-count method to determine the credit. The findings may differ if the fractional-count approach is used. (2) The country's groupings into region have been followed by the WHO classification. There will be some differences if different categories are chosen.

### Funding

Not applicable.

### Data availability

The data used in this study was collected from the Web of Science.

### Disclosure of interest

The author declares that he has no competing interest.

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