THE LITERATURE LANDSCAPE OF COVID-19 AND SOCIO-ECONOMIC RESEARCH: A BIBLIOMETRIC ANALYSIS

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Abstract: This study reviews the literature on COVID-19 and socio-economic studies to identify current research areas and suggest ways forward through bibliometric analysis of 426 published documents retrieved from the Scopus database concerning COVID-19, scientific and socio-economic research in the year 2020. The findings reveal that the pandemic affected the socio-economic domain through the imposed social distancing, applied based on different severity levels in various countries. This study shows that the most common keyword used in titles, abstracts and author keywords is "COVID-19". Two-authored documents have the highest number of total publications. The top affiliations are the University College London and the London School of Hygiene and Tropical Medicine. The United States is the top country in terms of total publications. The findings highlighted the increase in stress levels in the healthcare system during the COVID-19 pandemic and the necessity of scientific research to help scholars understand the various socio-economic impacts of this crisis. The most influential aspects of research are virus and protein interaction maps and the effects of the pandemic on economics and psychology. The main search stream is COVID-19 and its effects on health. This study has practical implications for policymakers and governments in implementing social policies to reduce anxiety in social situations among households and protect public health.

Keywords: Bibliometric, COVID-19, socio-economic.

Introduction

The pandemic caused by the 2019 coronavirus disease (COVID-19) has been considered as a socio-economic crisis that affects the core of human existence. The pandemic had an impact on all populations (Donthu & Gustafsson, 2020), as well as underdeveloped healthcare systems (Tanne *et al*., 2020; Martin *et al*., 2020). The extent of the disease spread in the population has greatly varied in different economies (Stojkoski *et al*., 2020). The World Health Organisation (WHO) announced that the outbreak was expected to peak in June 2020 and would begin to recede from July 2020. In response to the outbreak of the pandemic, the governments of most countries decided to enforce border closures and travel restrictions, in which all citizens were prohibited from leaving their homes. According to the World Trade Organisation, the pandemic has led to major economic downturns, crises and recession (Buck *et al.*, 2020; Public Health England, 2020). Moreover, the COVID-19 pandemic is a public health issue. Due to its high infection rate, it poses a major threat to global public health (Bogoch *et al.*, 2020). Its rapid spread affected the lives of various populations and disrupted patterns of social and economic development, which resulted in huge social and economic issues (Gao & Yu, 2020). Thus, the pandemic has brought harm on people's lives and global healthcare systems (Verma & Gustafsson, 2020). International organisations have announced that the global economy is currently in recession, affecting both developed and developing nations (OECD, 2020). It is, therefore, not surprising that the COVID-19 pandemic has obtained the attention of scholars and sparked a new wave of research in the socio-

economic domain. Socio-economic impacts have been attributed as an important criterion for COVID-19 outcomes.

In addition, the challenge of the COVID-19 pandemic has generated a tremendous amount of scientific research both within and outside the medical field to help people overcome this challenge by reducing its negative impacts. The enormity of scientific efforts and knowledge of the coronavirus pandemic, as well as its socio-economic effects, have created difficulties for everyone to be informed easily. Furthermore, while some countries followed specific common patterns, the majority of nations are still outliers in terms of officially documented cases. Therefore, the number of articles published on COVID-19 and its socio-economic impacts has increased recently.

Hence, in this short review, we conducted a bibliometric review analysis to find the trends of past studies on COVID-19, scientific studies and its related socio-economic impacts. Although the effects of COVID-19 have been addressed by a few recent bibliometric review papers (Haghani *et al*., 2020; Nasir *et al*., 2020; Hamidah *et al*., 2020; Verma & Gustafsson, 2020; Hossain, 2020; Park *et al*., 2020), each study suffers a set of limitations. Previous studies, such as Haghani *et al.* (2020), reviewed scientific coronavirus research and concentrated on safety-related literature. Yadav and Mohite (2020) reviewed COVID-19 with a focus on scientific and clinical research and infection. Nasir *et al.* (2020) limited their review to the coronavirus pandemic and social science, whereas Hamidah *et al.* (2020) limited their bibliometric analysis to co-word analysis.

Similarly, Verma and Gustafsson (2020) reviewed trends in COVID-19 research in business and management. Chahrour *et al*. (2020) examined only the most influential observational and therapeutic studies described in articles published in the PubMed and WHO databases. Hossain (2020) limited their bibliometric review in this area to a few numbers of articles based on the Web of Science (WoS) database and found that extending the COVID-19 pandemic-

related studies to the field of science with socio-economics was a necessity.

This study's bibliometric review provides multiple contributions to the literature. First, it expands previous review studies through the utilisation of the Scopus database with the keywords of "COVID-19", "Covid", "corona", or "coronavirus" and "science" or "scientific" and also "socio-economic" or "social and economic". Second, this study utilises a huge number of bibliometric analyses through different software and techniques to find more accurate and detailed results. Third, to the best of our knowledge, this is the first review concentrating on COVID-19 and scientific research with socio-economic effects and analysing them with multiple techniques.

The purpose of our bibliometric review is to identify and analyse descriptive publication patterns and the intellectual structure of COVID-19 across socio-economic research. In this study, we consider the following research questions as a systematic review of written publications that to shed light on the dynamics of COVID-19 and scientific research and socio-economic trends for future research.

1. What are the influential subject areas, the growth trends of publications and the influential aspects of COVID-19 and scientific research and its related socio-economic studies?

2. What are the key research themes in COVID-19 and scientific research and its related socio-economic studies?

3. What is the current state of collaboration involving COVID-19 and scientific research and its related socio-economic studies?

This review uses quantitative bibliometric analysis to identify 426 Scopus-indexed documents related to COVID-19 and scientific research and its related socio-economic studies published in the year 2020. We identified and analysed the extracted information from the database and documents and examined patterns and trends of the current status of studies.

The research streams may motivate scholars, policymakers and researchers to conduct future studies and responses to current problems.

Moreover, this study is a quantitative approach that can provide a systematic study of written publications. The rest of our review is organised as follows: Section 2 provides the procedure of bibliometric analysis and Section 3 presents the methods that were utilised by this study. The analyses and findings are presented in Section 4 and lastly, Section 5 concludes the paper with limitations and recommendations for future research.

Materials and Methods

The Procedure of the Bibliometric Analysis

A bibliometric analysis is a statistical method to quantitatively assess the growth trend of previous studies through multiple domains (Rehn *et al.*, 2007; Li *et al.*, 2016; Ellis, 2018). There are different classifications for bibliometric review indicators, which are quantity, quality and structural (Durieux & Gevenoi, 2010). Therefore, the productivity of publication trends is evaluated through quantity indicators and authors' output is analysed through qualitative indicators. The association between publications and researchers (which is related to co-authorship, co-citation and bibliometric coupling analysis) is referred to as a structural indicator (Van Eck & Waltman, 2014). The bibliometric analysis significantly enhances the literature review's quality by addressing a systematic, transparent and reproducible review process. It prepares tools for designing the fields of research and influential work without intuitive bias that is commanding for holistic aid to the literature process. This study used a research design that is related to the COVID-19 pandemic and the socio-economic field (Figure 1). This bibliometric study is novel as it gives an insight into research on COVID-19 and its socio-economic impacts, allowing for the finding and evaluation of patterns, as well as tendencies in the literature.

Data Sources

We identified several published research papers within the socio-economic field to answer the research questions of this study. Figure 1 summarises the research design and presents our search string and data retrieval process for conducting systematic research reviews (Moher *et al.*, 2009). Publications were retrieved from the Scopus database. Data collection from the existing literature is important for our study design as it determines the dataset of articles from which relevant conclusions can be drawn (Singh *et al.*, 2020).

This study used the data obtained from the Scopus index up to November 2020. The Scopus database is among the biggest scholarly works database in comparison with other databases, such as Web of Science (WoS) and PubMed. It also offers more comprehensive coverage of sources (Falagas *et al.*, 2008; Hallinger & Kovačević, 2019). The review adopted a broader search strategy by including article titles, abstracts and keywords in the search string. The Boolean strings selected are "COVID-19" or "coronavirus" and "scientific" or "science", as well as "socio-economic" or "social and economic". This search string strategy is constructed to capture the many facets as follows: Year, author name, subject area, document type, source title, publication stage, keyword, affiliation, country, source type and language. Having identified 518 documents in 2020, we limited the document types to articles, conference papers, book chapters and reviews published in English. Based on the query, a total of 426 documents were available for bibliographic analysis.

To conduct a review on COVID-19 and scientific research and its related socio-economic research, we used bibliometric analysis by using subject areas, publication trends, citation analysis, keyword co-occurrence analysis and authorship and co-authorship analysis tools responding to our research questions (Castriotta *et al.*, 2019). The keyword co-occurrence displays the conceptual concept of previous studies (Callon *et al.*, 1983). Besides, co-

authorship shows the authorship pattern and association between authors (Koseoglu, 2016). In examining the bibliometric analysis, there are some tools to examine the data. For this study, we used (1) Microsoft Excel to calculate the frequency of published material and produce corresponding charts and graphs (Persson *et al.*, 2009); (2) VOSviewer to construct and visualise the bibliometric networks and to synthesise the knowledge production's patterns in the literature (Van Eck & Waltman, 2014); and (3) Harzing's

Publish and Perish software to calculate citation metrics and other frequencies (Harzing, 1997).

Results

This review utilised and analysed data that included bibliographic information. This information describes COVID-19 and scientific research with socio-economic-related research in the year 2020 based on 426 documents indexed in the Scopus database. This meta-
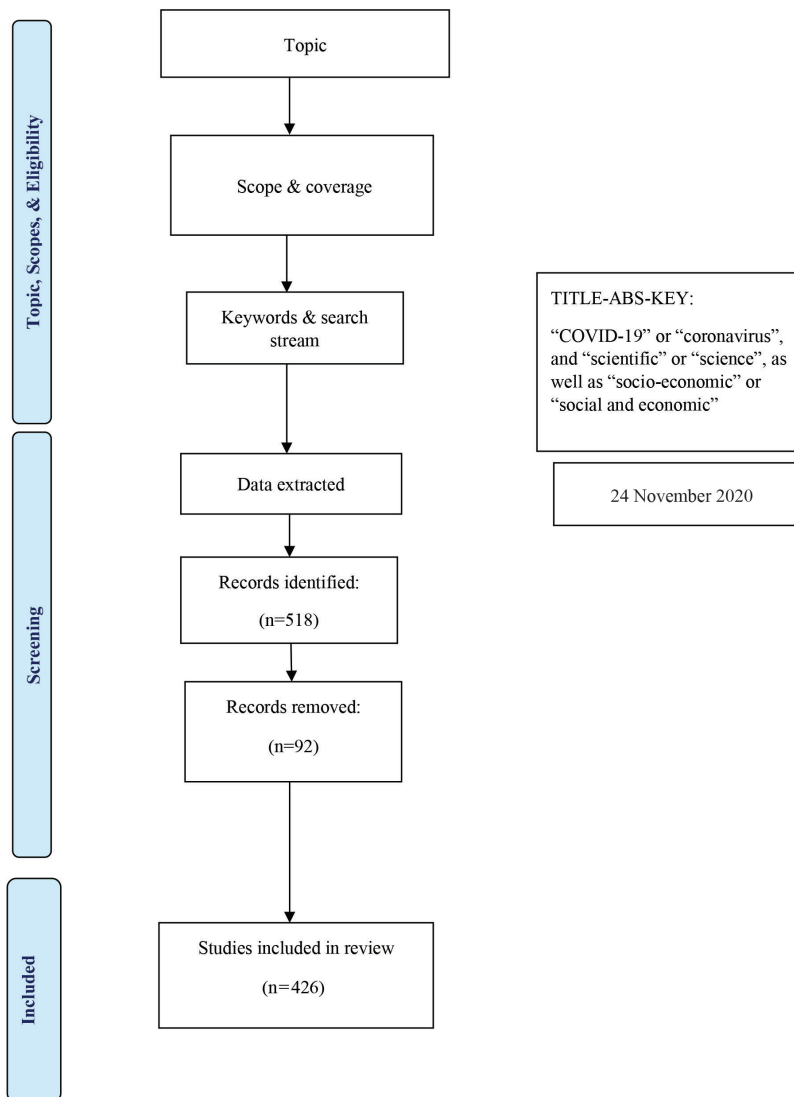

Figure 1: Research design for the bibliometric study

data contains the subject area, publication trend, citation analysis, keywords analysis and authorship and co-authorship analysis.

Subject by Area

To answer our first research question (RQ1) (What are the influential subject areas in COVID-19 and scientific research and its related socio-economic studies?), Table 1 depicts the published documents based on their subject areas. The research CPVOD COVID-19 with scientific and socio-economic areas in 2020 are mostly in the fields of

medicine, representing 46% of the total documents with a total publication (TP) of 196, followed by social science (29.58%) with TP of 126, environmental science (16.9%) with TP of 72 and biochemistry, genetics and molecular biology (10.33%) with TP of 44. The other subject areas covered in CPVOD-19 and scientific literature with related socio-economic research are tabulated in Table 1.

Publication Trends

To answer RQ2 (What are the growth trends and trajectories of publications in COVID-19

Table 1: Subject area

Subject Area	TP	Percentage (%)
Medicine	196	46.01%
Social Sciences	126	29.58%
Environmental Science	72	16.90%
Biochemistry, Genetics and Molecular Biology	44	10.33%
Psychology	35	8.22%
Engineering	30	7.04%
Business, Management and Accounting	29	6.81%
Agricultural and Biological Sciences	26	6.10%
Economics, Econometrics and Finance	24	5.63%
Energy	22	5.16%
Computer Science	20	4.69%
Arts and Humanities	21	4.93%
Immunology and Microbiology	16	3.76%
Mathematics	10	2.35%
Multidisciplinary	13	3.05%
Pharmacology, Toxicology and Pharmaceutics	12	2.82%
Nursing	9	2.11%
Neuroscience	8	1.88%
Chemistry	7	1.64%
Decision Sciences	6	1.41%
Health Professions	6	1.41%
Earth and Planetary Sciences	5	1.17%
Materials Science	4	0.94%
Chemical Engineering	3	0.70%
Physics and Astronomy	2	0.47%
Dentistry	1	0.23%

Notes: TP = total number of publications

scientific research and its related socio-economic studies?), we evaluate the publication trends for core countries, journals (source titles), contributing authors, institutions of COVID-19 and scientific literature in the field of socio-economics research and impacts.

Publication by Country

According to our database, scholars from 79 countries have contributed to the publication of the retrieved documents in the field of COVID-19, scientific and its related socio-economics research. Table 2 lists countries that contributed a minimum of ten publications ranked by total publication (TP), total citation (TC) and h-index in the year 2020.

The United States has the highest number of contributions to the amount of publication at TP of 134 and TC of 9277. This is followed by the United Kingdom (TP=108, TC=10270), India (TP=83, TC=2956) and Italy (TP=64, TC=3331). The United Kingdom has the highest TC, followed by the United States. Meanwhile, the United States ranked first in h-index at 43, followed by the United Kingdom with an h-index of 34 and Italy with an h-index of 28.

Publication by Institutions

According to Table 3, most of the research in the field of COVID-19 and socio-economics research within the last five years comes from the University College London and the London

Table 2: Countries contributing a minimum of ten publications

Country	TP	TC	h
United States	134	9277	43
United Kingdom	108	10270	34
India	83	2956	24
Italy	64	3331	28
Australia	43	1810	22
South Africa	43	964	14
China	37	2425	18
Canada	31	1262	15
Germany	27	967	16
Brazil	21	312	9
France	19	2656	13
Japan	16	914	11
Spain	15	792	10
Pakistan	14	272	8
Netherland	13	343	8
Nigeria	13	360	8
Saudi Arabia	12	619	9
Singapore	12	596	8
Malaysia	11	738	8
Bangladesh	10	551	9
Indonesia	10	237	7
Kenya	10	393	7

Notes: TP = total number of publications, TC = total citations, h = h-index

School of Hygiene and Tropical Medicine, both in the United Kingdom with TPs of 13 and followed by the University of Oxford, the United Kingdom, with a TP of 12. Universiteit van Pretoria in South Africa is the third-most influential institution with a TP of 10. The United Kingdom has the most active research institutions involving COVID-19 and socio-economics research, with 10 institutions from the influential organisations category with a minimum of five publications. Meanwhile, the institution with the highest number of TC and

Table 3: Influential institutions with a minimum of five publications

Affiliation	Country	TP	TC	C/P
University College London	United Kingdom	13	4078	313.69
London School of Hygiene and Tropical Medicine	United Kingdom	13	882	67.85
University of Oxford	United Kingdom	12	349	29.08
Universiteit van Pretoria	South Africa	10	84	8.40
Harvard T.H. Chan School of Public Health	United States	10	283	28.40
King's College London	United Kingdom	9	2956	328.44
Imperial College London	United Kingdom	9	310	34.44
Chinese Academy of Sciences	China	9	279	31.00
University of Melbourne	Australia	9	300	33.33
Harvard Medical School	United States	8	344	43.00
The University of Sydney	Australia	8	577	72.13
Harvard University	United States	7	257	5.57
University of KwaZulu-Natal	South Africa	7	145	20.71
Alma Mater Studiorum Università di Bologna	Italy	7	76	10.86
University of New South Wales UNSW Australia	Australia	7	386	55.14
University of Johannesburg	South Africa	6	48	8.00
Stellenbosch University	South Africa	6	249	41.00
CNRS Centre National de la Recherche Scientifique	France	6	2059	342.00
University of Toronto	Canada	6	133	22.17
National University of Singapore	Singapore	6	104	17.33
University of Chinese Academy of Sciences	China	6	210	35.00
University of California, San Diego	United States	6	2523	420.5
Università degli Studi di Padova	Italy	5	234	46.8
Inserm	France	5	265	53.00
Sorbonne Universite	France	5	257	51.4
London School of Economics and Political Science	United Kingdom	5	238	47.6
Mahidol University	Thailand	5	126	25.2
University of Bristol	United Kingdom	5	308	61.6
Lancaster University	United Kingdom	5	194	4.4
University of Exeter	United Kingdom	5	319	7.8
University of Cambridge	United Kingdom	5	854	170.8
Universidade Nova de Lisboa	Portugal	5	32	6.40

Notes: TP = total number of publications, TC = total citations, C/P = average citations per publication

citations per publication (C/P) is the University College London in the United Kingdom at 4078 and 313.69, respectively.

Publication by Contributing Author

Table 4 shows the productive authors with a minimum of two publications. As shown in the table, the top productive authors in the field of COVID, scientific and its related and socio-economics research are Ikoona, E.N., Kitara, D.L. from Gulu University, Uganda; and Lanari, M. from Alma Mater Studiorum Università di Bologna of Italy. Alias, H. and Wong, L.P. from the University of Malaya in Malaysia have the highest TC at 583, followed by Amerio, A. from Ospedale Policlinico San Martino in Italy.

Table 4: Productive authors with a minimum of two publications

Author's Name	Affiliation	Country	TP	TC
Ikoona, E.N.	Gulu University	Uganda	3	10
Kitara, D.L.	Gulu University	Uganda	3	10
Lanari, M.	Alma Mater Studiorum Università di Bologna	Italy	3	45
Affanni, P.	University of Parma	Italy	2	19
Alias, H.	University of Malaya	Malaysia	2	583
Allam, Z.	Deakin University	Australia	2	245
Amerio, A.	Ospedale Policlinico San Martino	Italy	2	515
Asmundson, G.J.G.	University of Regina	Canada	2	475
Avila, R.H.	Universidad de Sucre	Colombia	2	0
Bhargava, M.	Yenepoya	India	2	2
Chattu, V.K.	University of Toronto	Canada	2	59
Checchi, F.	London School of Hygiene and Tropical Medicine	United Kingdom	2	69
Díaz, J.J.F.	Tecnológico Nacional de México	Mexico	2	0
Edmunds, W.J.	London School of Hygiene and Tropical Medicine	United Kingdom	2	59
Eggo, R.M.	London School of Hygiene and Tropical Medicine	United Kingdom	2	84
Flasche, S.	London School of Hygiene and Tropical Medicine	United Kingdom	2	69
Funk, S.	London School of Hygiene and Tropical Medicine	United Kingdom	2	84
Gelfand, M.	Stanford Graduate School of Business	United States	2	165
Gimma, A.	London School of Hygiene and Tropical Medicine	United Kingdom	2	59
Hung, A.	RMIT University	Australia	2	39
Iacus, S.M.	European Commission Joint Research Centre	Belgium	2	168

Jarvis, C.I.	London School of Hygiene and Tropical Medicine	United Kingdom	2	59
Jones, D.S.	Wadawurrung Traditional Owners Aboriginal Corporation	Australia	2	245
Karagiannis, T.C.	Nursing and Health Sciences	Australia	2	39
Landry, C.A.	University of Regina	Canada	2	475
Liang, J.	RMIT University	Australia	2	39
Mbunge, E.	University of Eswatini	Swaziland	2	123
Misra, A.	Fortis CDOC Hospital for Diabetes and Allied Sciences	India	2	134
Mpofu, B.	University of Pretoria	South Africa	2	4
Ngonghala, C.N.	University of Florida	United States	2	32
Niankara, A.	The National Office of Workers' Health	Burkina Faso	2	15
Niankara, I.	Al Ain University	United Arab Emirates	2	15
Oyebode, O.	Warwick Medical School	United Kingdom	2	207
Paluszek, M.M.	University of Regina	Canada	2	475
Pearson, C.A.B.	London School of Hygiene and Tropical Medicine	United Kingdom	2	84
Pitsillou, E.	Nursing and Health Sciences	Australia	2	39
Pizzol, D.	Italian Agency for Development Cooperation	Sudan	2	282
Prem, K.	London School of Hygiene and Tropical Medicine	United Kingdom	2	59
Racalbuto, V.	Italian Agency for Development Cooperation	Sudan	2	282
Ratnayake, R.	Epicentre	France	2	69
Ripoll, S.	University of Sussex	United Kingdom	2	115
Santamaria, C.	European Commission Joint Research Centre	Belgium	2	168
Serafini, G.	Università degli Studi di Genova	Italy	2	517
Sharifi, A.	Hiroshima University	Japan	2	338
JaSignorelli, C.	Università Vita-Salute San Raffaele	Italy	2	133
Smith, L.	Anglia Ruskin University	United Kingdom	2	282

Spyratos, S.	European Commission Joint Research Centre	Belgium	2	168
Swart, K.	Hamad Bin Khalifa University	Qatar	2	11
Taylor, S.	Faculty of Medicine	Canada	2	475
Van Zandvoort, K.	London School of Hygiene and Tropical Medicine	United Kingdom	2	70
Vespe, M.	European Commission Joint Research Centre	Belgium	2	168
Wilches, F.J.	Universidad de Sucre	Colombia	2	0
Wong, L.P.	University of Malaya	Malaysia	2	583
Zabaniotou, A.	Aristotle University of Thessalonik	Greece	2	26
Zwart, H.	Radboud Universiteit	Netherlands	2	1

Notes: TP = total number of publications, TC = total citations

Publication by Source Titles

The studies of COVID-19, scientific and socio-economics effects were published in various source titles, such as journals and reviews. Table 5 shows the active source titles with a minimum of three publications in the form of research published in journals. The 426 documents appear in 159 journals. The most active source titles were categorised based on TP, TC, published, Scopus's cite score, scientific journal rankings (SJR) and the 2021 source normalised impact per paper (SNIP). The leading journals are *International Journal of Environmental Research and Public Health* (TP=18, TC=777), followed by *Sustainability Switzerland* (TP=17, TC=375), PLOS ONE (TP=11, TC=436), *Science of the Total Environment* (TP=9, TC=1377) and *Diabetes and Metabolic Syndrome Clinical Research and Reviews* (TP=8, TC=385). Meanwhile, the journal with the highest cite score is *Science of the Total Environment* (14.1) and the lowest (0.2) is the *International Journal of Research in Pharmaceutical Sciences*. Elsevier is the most active publisher in terms of active journals with a minimum of three publications in the field of COVID-19, science and socio-economics-related research.

Table 5: Active source titles with a minimum of three publications

Source Title	TP	TC	Publisher	Cite Score	SJR 2021	SNIP 2021
International Journal of Environmental Research and Public Health	18	777	MDPI	4.5	0.814	1.440
Sustainability Switzerland	17	375	MDPI	5.0	0.664	1.310
PLOS ONE	11	436	Public Library of Science	5.6	0.852	1.368
Science of the Total Environment	9	1377	Elsevier	14.1	1.806	2.175
Diabetes and Metabolic Syndrome Clinical Research and Reviews	8	385	Elsevier	10.0	1.587	1.896

Frontiers in Public Health	7	343	Frontiers Media S.A.	4.0	1.298	1.949
Pan African Medical Journal	7	35	Pan African Medical Journal	1.0	0.283	0.509
IEEE Access	6	135	IEEE	6.7	0.927	1.326
Public Health	6	213	Elsevier	4.5	0.973	1.334
International Journal of Research in Pharmaceutical Sciences	5	0	JK Welfare & Pharmascope Foundation	0.2	0.119	0.202
Scientific Reports	5	221	Springer Nature	6.9	1.005	1.389
Acta Biomedica	4	149	Mattioli 1885 SpA	2.8	0.521	0.948
Annals of Medicine and Surgery	4	49	Elsevier	1.4	0.373	0.965
BMJ Global Health	4	221	BMJ Publishing Group	7.2	2.263	2.456
Frontiers in Psychiatry	4	134	Frontiers Media S.A.	4.6	1.279	1.522
Frontiers in Psychology	4	212	Frontiers Media S.A.	4.0	0.873	1.605
Safety Science	4	357	Elsevier	10.1	1.438	2.297
BMC Medicine	3	193	Springer Nature	12.8	3.405	3.184
Fiscal Studies	3	282	Wiley-Blackwell	5.2	1.271	2.597
Heliyon	3	53	Elsevier	4.0	0.550	1.270
International Social Work	3	22	SAGE	2.5	0.594	1.172
Journal of Global Health	3	16	Edinburgh University Global Health Society	5.1	1.349	1.716
Journal of Medical Internet Research	3	171	JMIR Publications Inc.	8.2	1.736	2.318
New Microbes and New Infections	3	52	Elsevier	5.2	0.737	1.039
Wellcome Open Research	3	95	Taylor & Francis	5.2	1.777	1.273
Work	3	38	IOS Press	2.0	0.437	0.872

Notes: TP = total number of publications, TC = total citations

Citation Analysis

To answer our RQ3 (What are the influential aspects of COVID-19 scientific research and its related socio-economic studies?), the Harzing's Publish or Perish software was used in this study to find the citation metrics for the retrieved documents. The top 20 cited papers in this area of research are listed in Table 6. These papers are mostly listed in Q1 journals ranked by Scopus. An article entitled "The socio-economic implications of the coronavirus pandemic (COVID-19): A review" by Nicola *et al*. (2020) received the highest number of citations in Scopus database, with a total of 2,535 citations. This paper summarised the socio-economic impacts of COVID-19 according to individual aspects globally. The second highest cited article, with the title "A SARS-CoV-2 protein interaction map reveals targets for drug repurposing", is written by Gordon *et al*. (2020) with TC of 1966. The authors identified 332 high-confidence protein-protein interactions between SARS-CoV-2 and human proteins. An article by Ellul *et al*. (2020) with the title of "Neurological associations of COVID-19" is the third-highest citation with a TC of 945.

Based on the citation number of the top 20 cited papers in the field of COVID-19 and scientific research and its related socio-economic studies, the first tendency of the global scholar is to study the type of virus and protein interaction map to reuse drugs. However, the world has quickly concentrated on issues concerning the effect of COVID-19 on the economy and

Table 6: Top 20 highly cited articles

No.	Authors	Title	Cites
1	Nicola *et al*.	"The socio-economic implications of the coronavirus pandemic (COVID-19): A review"	2535
2	Gordon *et al*.	"A SARS-CoV-2 protein interaction map reveals targets for drug repurposing"	1966
3	Ellul *et al*.	"Neurological associations of COVID-19"	945
4	Di Renzo *et al*.	"Eating habits and lifestyle changes during COVID-19 lockdown: An Italian survey"	818
5	Bambra *et al*.	"The COVID-19 pandemic and health inequalities"	593
6	Muhammad *et al*.	"COVID-19 pandemic and environmental pollution: A blessing in disguise?"	551
7	Serafini *et al*.	"The psychological impact of COVID-19 on the mental health in the general population"	468
8	Troyer *et al*.	"Are we facing a crashing wave of neuropsychiatric sequelae of COVID-19? Neuropsychiatric symptoms and potential immunologic mechanisms"	453
9	Taylor *et al*.	"Development and initial validation of the COVID Stress Scales"	439
10	Han *et al*.	"Lessons learnt from easing COVID-19 restrictions: An analysis of countries and regions in Asia Pacific and Europe"	325
11	Wong *et al*.	"The use of the health belief model to assess predictors of intent to receive the COVID-19 vaccine and willingness to pay"	325
12	Sharifi *et al*.	"The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design and management"	298
13	Di Gennaro *et al*.	"Coronavirus diseases (COVID-19) current status and future perspectives: A narrative review"	282
14	Blundell *et al*.	"COVID-19 and Inequalities"	259
15	Lin *et al*.	"Understanding COVID-19 vaccine demand and hesitancy: A nationwide online survey in China"	258
16	Fernandez *et al*.	"Implications for COVID-19: A systematic review of nurses' experiences of working in acute care hospital settings during a respiratory pandemic"	256
17	Qiu *et al*.	"Impacts of social and economic factors on the transmission of coronavirus disease 2019 (COVID-19) in China"	222
18	Shaw *et al*.	"Governance, technology and citizen behavior in pandemic: Lessons from COVID-19 in East Asia"	215
19	Daly *et al*.	"Longitudinal changes in mental health and the COVID-19 pandemic: Evidence from the UK Household Longitudinal Study"	207
20	Allam *et al*.	"On the coronavirus (COVID-19) outbreak and the smart city network: Universal data sharing standards coupled with artificial intelligence (AI) to benefit urban health monitoring and management"	191

psychology. It means scholars find these issues more important than other issues when it comes to COVID-19. Moreover, the positive effect of COVID-19 on reducing environmental pollution has also attracted scholar attention.

Co-occurrence of Keywords

To address our RQ4 (What are the key research themes in COVID-19 scientific research and its related socio-economic studies?), we use keyword and co-occurrence (co-word) analysis as authors' keywords show the documents' content (Nasir *et al.*, 2020). Keyword co-occurrence networks usually utilises graphical visualisations of the potential relationships between the keywords in the documents. Therefore, in this study, we use the keyword co-occurrence analysis (co-word analysis) in VOSviewer, as Van Eck and Waltman (2014) stated that the number of co-occurrence of

two keywords is the number of publications in which both keywords occur together in the title, abstract or keyword list. This type of analysis is used by scholars to measure the performance of combination channels and information circulations (Su & Lee, 2010).

Figure 2 depicts the full co-occurrence network of authors' keywords. The co-occurrence analysis was evaluated with a minimum number of occurrences of five keywords that met 30 terms. The size of a node refers to the frequency of occurrence. "COVID-19", "coronavirus", "pandemic", "SARS-CoV-2" and lockdown are the most distinctive nodes in the network graph, which depict their prominent roles in this field of research. The co-occurrence network of keywords shows that the literature on COVID-19 and socio-economic research can be divided into six clusters. The red cluster is the central cluster that shows high centrality and the green
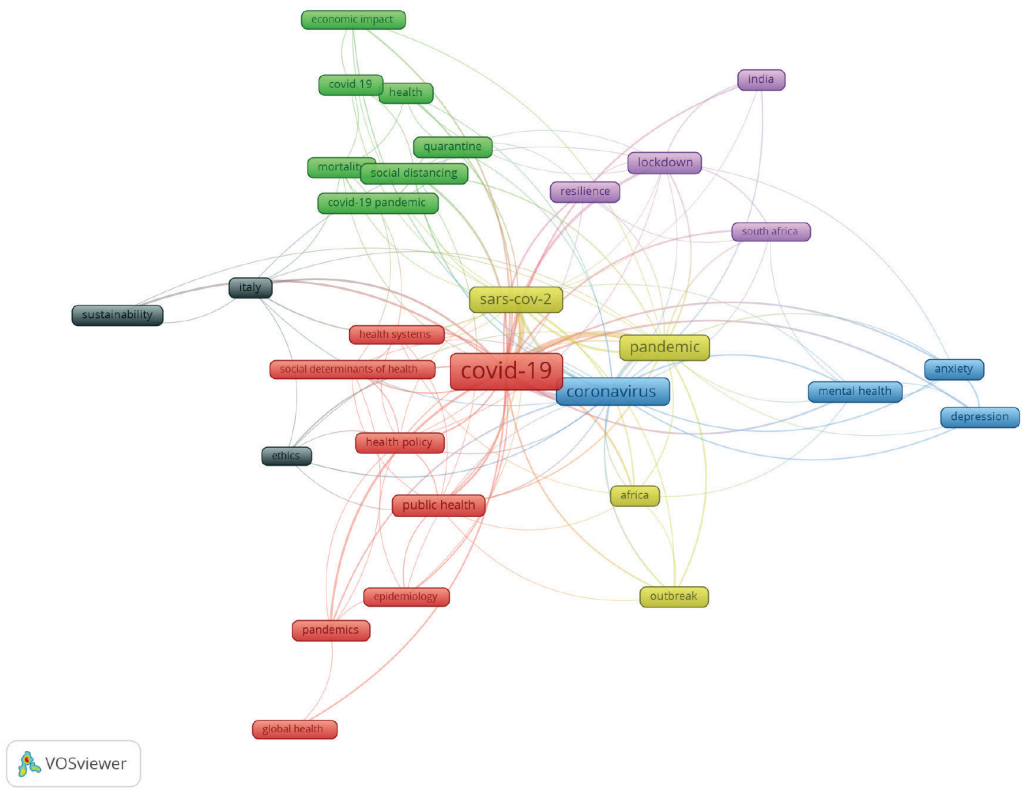

Figure 2: The network visualisation map of the authors' keywords

and blue clusters are linked together in terms of themes. Each group divides the literature on the coronavirus into various research streams.

According to the network visualisation map, the red cluster represents the main discussion of COVID-19 with health research. This research stream is named "COVID-19 and its effects on health". This cluster represents keywords, such as "COVID-19", "epidemiology", "global health", "health policy", "health system" and "social determinants of health".

The green cluster shows the research stream of "economic impacts of COVID-19". In this cluster, "economic impact", "COVID-19 pandemic", "health", "mortality", "quarantine" and "social distancing" are dominant.

The blue cluster indicates the research stream of "stress and anxiety related to COVID-19". This cluster depicts keywords such as "depression", "anxiety", "mental health" and "coronavirus".

The yellow cluster's main research stream is "SARS and COVID-19 difference". In this cluster, "pandemic", "SARS-CoV-2", "Africa" and "outbreak" were significant.

The purple research stream is "lockdown and COVID-19". In this cluster, "resilience", "lockdown", "South Africa" and "India" were dominant. And finally, the grey cluster's research stream is "sustainability and COVID-19", in which "sustainability", "ethics" and "Italy" were significant.

Authorship and Co-authorship Analysis

Our final research question (RQ5) (What is the current state of collaboration involving COVID-19 and scientific research and its related socio-economic studies?) was addressed through the application of authors per document and co-authorship analysis to analyse the current state of authors' collaborations. Table 7 depicts the number of the author(s) per document in the field of COVID-19, scientific and socio-economic related research in the year 2020. The highest number of TP (73) at 17% are related to two-authored documents, followed by three-authored documents with TP of 69 at 16% and single-authored documents with TP of 58 at 14%. There is one document in which the author's name was not listed based on the Scopus database.

We conducted the co-authorship analysis using the VOSviewer visualisation network to uncover an author's cooperation link with COVID-19 and scientific research and its related socio-economic studies. This is important as authors' TP and TC help experts in a related field of research enhance the reliability/visibility of their research output. Indeed, according to Palacios-Callender and Roberts (2018), having international collaboration networks helps emerging countries enhance their maturity of ideas and the quality of their work by obtaining some guidance from published documents in developed countries.

Besides, mostly multi-authored published articles have fewer mistakes in their output (Tahamtan *et al.*, 2016). The co-authorship for 93 countries is shown in Figure 3, which shows the density visualisation based on the co-authorship and countries. The countries are divided into six clusters with 31 items. The intensity of hotspots is depicted according to colour, with warm red colours representing hot areas and cool blue colours representing cold areas.

Among the countries, the United States has the highest number of documents and, therefore, the highest intensity at 131, followed by India with 55 documents, Italy with 50 documents and Australia and South Africa with 30 documents. It is worth mentioning that the size of the nodes in the map represents the quantity of research activity in each country for COVID-19, scientific and socio-economic research areas.

Discussion

The COVID-19 pandemic has had a huge impact on healthcare systems and populations of different economic systems (Tanne *et al.*, 2020; Martin *et al.*, 2020; Jolakoski *et al.*, 2020). From an academic research perspective, holistic interdisciplinary approaches and collective

Table 7: Number of authors per document

Author Count	Total Publications (TP)	Percentage (%)
0	1	0%
1	58	14%
2	73	17%
3	69	16%
4	43	10%
5	47	11%
6	30	7%
7	20	5%
8	20	5%
9	14	3%
10	12	3%
11	3	1%
12	5	1%
13	5	1%
14	2	0%
15	4	1%
16	1	0%
17	3	1%
18	2	0%
19	2	0%
20	4	1%
23	1	0%
32	1	0%
34	2	0%
43	1	0%
47	1	0%
50	1	0%
Total	**426**	**100.00**

Notes: TP = total number of publications

scientific efforts have shown that COVID-19 has brought harmful consequences on the socio-economic perspective of human life and the healthcare system (Verma & Gustafsson, 2020).

This study provides a bibliometric analysis on the current published documents in the field of COVID-19, scientific and its related socio-economic domain on the Scopus database in 2020. For this purpose, we first focused on influential subject areas in COVID-19 across scientific and socio-economic-related research (RQ1). We found that the top three subject areas are medicine, social science and environmental science. COVID-19 has affected every aspect of human life. Consistent with these concerns, governments and the scientific community have responded swiftly to address the pandemic. This effort is dedicated to the
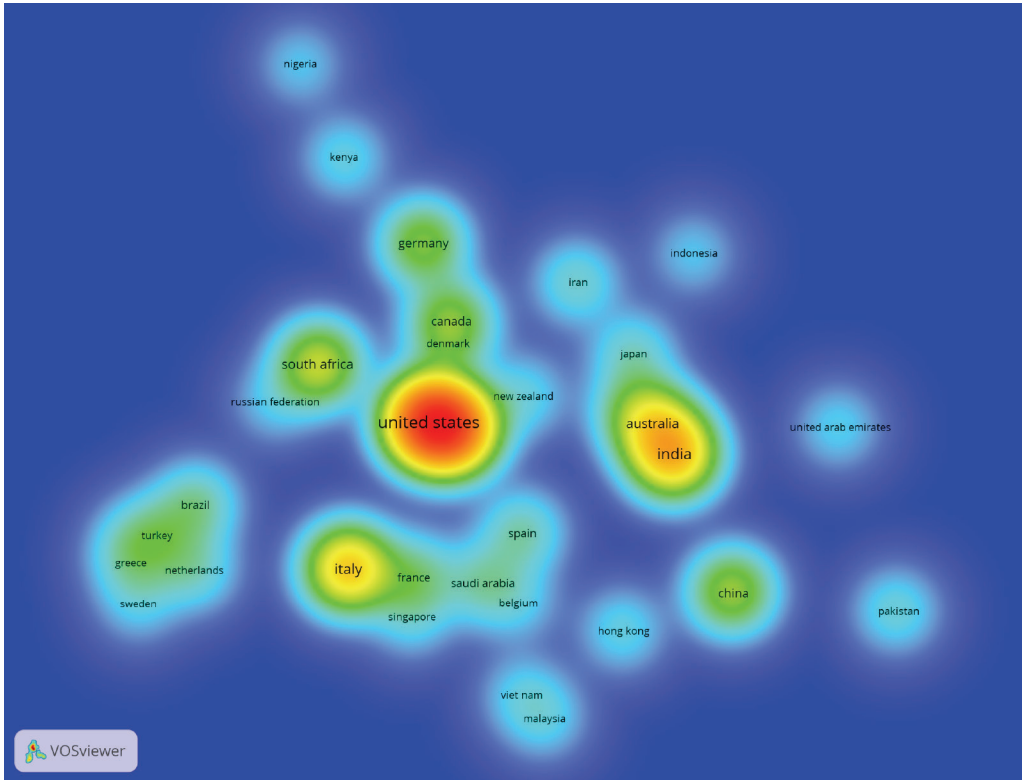
Figure 3: Density visualisation map of the co-authorship according to country

development of vaccines and medicine subject areas. Additionally, science has played a central role in informing policymakers in terms of the response to COVID-19 (Zyoud & Zyoud, 2021). However, successfully implementing these policies and ensuring long-term recovery are the tasks of the social and environmental sciences.

Second, we concentrated on the descriptive analysis in terms of volume and growth of publication to clarify the current trend of topics related to COVID-19 across scientific and socio-economic research (RQ2). We found the United States is the country with the highest number of contributions in terms of publication, followed by the United Kingdom and India. In terms of institutions, the University College London and the London School of Hygiene and Tropical Medicine from the United Kingdom are the most influential in the study area of COVID-19 and scientific research and its associated socio-economic related research, followed by the

University of Oxford in the United Kingdom and Universiteit van Pretoria. Moreover, among core authors, Ikoona, E.N., Kitara, D.L. from Gulu University, Uganda; and Lanari, M. from Alma Mater Studiorum Università di Bologna of Italy are the top productive authors in this field of research. Also, the top three journals are *International Journal of Environmental Research and Public Health*, *Sustainability Switzerland* and PLOS ONE.

Third, we answered RQ3 (What are the influential aspects of COVID-19 and scientific and its related socio-economic research?) by interpreting the results of the published documents based on citation metrics and core authors in this field. Our findings show that there were 26,407 citations. Also, the top three core authors based on citations were Nicola *et al.* (2020) for the article "The socio-economic implications of the coronavirus pandemic (COVID-19): A review", Gordon *et al.* (2020) for the article "A SARS-

CoV-2 protein interaction map reveals targets for drug repurposing" and Ellul *et al.* (2020) for the article "Neurological associations of COVID-19". Based on our findings, although the top-cited paper discussed the type of virus and repurposing of the drug usage, the majority of highly cited articles for COVID-19 research concentrated on economics and psychology. As a result, countries and governments have paid more attention to the economic effects and its effect on people's behavior and lifestyle rather than seeking medicine or vaccines for this virus.

Fourth, we responded to our RQ4 (What are the key research themes in COVID-19 and scientific and its related socio-economic research?) by focusing on keyword and co-word (co-occurrence) analysis on the literature on COVID-19, scientific and its related socio-economic domain. We analysed our data based on the Scopus dataset in 2020. The results suggested that the most frequent author keyword in this field of research is "pandemic", followed by "coronavirus infection", "coronavirus disease" and "human". Also, in clusters red, green, blue, yellow, purple and grey, the highest number of occurrences are associated with "COVID-19", "COVID-19 pandemic", "coronavirus", "SARS-CoV-2", "lockdown" and "sustainability", respectively.

Fifth, we focused on co-authorship analysis to respond to RQ5 (What is the current state of collaboration involving COVID-19 and scientific and its related socio-economic research?) in the mentioned field of study. The results showed that two-authored documents have the highest TP, followed by three-authored documents and single-authored documents. The highest density of co-authorship is connected to the United States, India and Italy.

Conclusion

The current study reviews all published documents through bibliometric analysis on the topics, titles and abstracts of the literature on COVID-19, scientific and its related socio-economic domain based on 426 documents on the Scopus database in the year 2020. As the bibliometric results are a good representation of the current literature on the related topic, this study provides a significant perspective of COVID-19 research. The pandemic has influenced the socio-economic domain through forced social distancing, which was applied depending on the different levels of severity in different nations. The COVID-19 pandemic has also resulted in an increase in stress on the healthcare infrastructure and strain on the economic system, as well as a rise in social anxiety among citizens (Bloom & Cadarette, 2019; Aduhene & Osei-Assibey, 2021). Based on the findings, the top affiliations are both the University College London and the London School of Hygiene and Tropical Medicine, with the top subject being Medicine.

This study makes a prominent contribution to the literature in this field of study. First, the protection of public health requires a review of the related social and economic aspects. To the best of our knowledge, this is among the first review studies that use numerous bibliometric analysis types to review the published documents on COVID-19 and scientific research and its associated socio-economic-related research. Second, we examined the volume and growth of publications in this field of research by analysing the publications by authors, countries and institutions. Third, we determined the most effective articles, keywords and authors by mapping citations, subject analyses, co-occurrence, authorship and co-authorship analysis. Finally, we performed bibliometric analysis through the Scopus database, which is among the most extensive and high-quality bibliometric data sources for academic research online databases (Baas *et al.*, 2020).

The results of this bibliometric analysis have some important implications in terms of evaluating the COVID-19 pandemic based on the socio-economic domain. These analyses provide a collection of key data and information to scientists, scholars and decision-makers on the contributions of countries, institutions, social sources and authors at the global level in fields of research in relation to the socio-economic domain and the COVID-19 pandemic.

Additionally, investigating research hotspots and frontiers and displaying them in terms of the relevant studies can allow institutions and policymakers access to sufficient data and even trends in their investments for COVID-19 and the socio-economic field. Collaborative trends and globally influential countries, authors, institutions and journals form the basis of future assessments in relation to COVID-19 and scientific research. As a case in point, at the country level, the number of publications and total citations according to the country can be used to recognise the progress of research productivity in these countries in the future. Eventually, when a future evaluation shows that the productivity of a specific country is increasing in comparison to the produced one in the current assessment, this can show the progress of the country in moving towards promoting research in this area. This also applies to other bibliometric metrics (e.g., authorship and co-authorship analysis, co-occurrence of keywords).

This study has some limitations. First, the Scopus database is mostly used by scholars due to its high flexibility for bibliometric analysis in comparison with other databases, as well as high-quality bibliometric analyses as it contains many features and has higher flexibility than other databases. However, it does not include the online versions of published works before inclusion on certain issues (Falagas *et al.,* 2008). This might have excluded some related research published in other databases. Therefore, it is suggested that researchers add more sources in terms of the database for COVID-19 and social and economic outcomes research to provide comprehensive information in future.

Second, this study excluded other types of documents, such as letters and commentaries, which may have contributioned in this field of study.

Third, there is very limited literature available on COVID-19 and scientific literature across the socio-economic research landscape. Thus, more studies are required to deal with the needs of humans and the economic situation during a pandemic. Besides, more research is needed to identify the socio-economics outcomes of the novel coronavirus in comparison with the SARS virus (old family of coronavirus).

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