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.

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Regular Article

A bibliometric analysis of pandemic and epidemic studies in economics: future agenda for COVID-19 research

Masnun Mahi [a,b,*], Mohammad Ashraful Mobin [b], Marzia Habib [b], Shabiha Akter [b,c]

[a] Department of Finance and Banking, Faculty of Business and Accountancy, University of Malaya, Malaysia
[b] Ifintell Business Intelligence, Malaysia
[c] School of Accounting and Finance, Faculty of Business and Law, Taylor's University, Malaysia

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ABSTRACT

With the rapid global spread of the COVID-19 pandemic, researchers from diverse fields of study have contributed markedly in different research aspects. Considering the substantial economic significance of the pandemic at the micro and macro level throughout the world, we review the scientific publications in the discipline of Economics. To draw a broad inference, we analyze a total of 1,636 scientific publications starting from 1974, which covers the period of earlier pandemics or epidemics that have a close association with COVID-19 using bibliometric analysis. Our analysis and mapping reveal key information related to the contributors at different levels, including author, institution, country, and publication sources. Besides, we identify the historical concentration of research using scientific clustering and illustrate transformations at different times. Moreover, recognizing the underlying inadequacy of economics research, we propose several areas of future research. Our findings and suggestions are expected to act as a roadmap to potential research opportunities and notable implications for business and policymakers.

1. Introduction

The Coronavirus disease 2019 (COVID-19) outbreak shocked the world since the first reported case in Wuhan, China, on December 31, 2019. Since then, it has spread all over the world and changed every aspect of human life. The infectious disease crisis, in turn, affects the world economy severely since governments around the world have been taking different policies to tackle the pandemic. The COVID-19 pandemic and related economic and financial crisis are different from others; the gravity of this pandemic, its high contagiousness, and a large number of infections and deaths resulting from it all contribute to the instability in the market and economy (Baker et al., 2020). Moreover, with the recent advancements in technology, all sorts of news and information regarding the pandemic quickly reach all corners of the world in no time. Early estimates have predicted that major economies will lose around 2.4 to 3.0 per cent of their gross domestic product (GDP) during 2020 due to the COVID-19 pandemic (Azevêdo, 2020). Accordingly, it is becoming challenging for most businesses worldwide to keep their financial wheels rolling, given reduced revenues and high uncertainty (Verma & Gustafsson, 2020). Therefore, being a health-related issue, the economic consequences of the COVID-19 pandemic pose a major question for the current and future.

To understand the crisis better and develop feasible solutions, there is an urge for comprehensive studies to analyze different facets of COVID-19. Realizing the importance, the World Health Organization (WHO) identified social sciences in the outbreak response as one of nine cutting edge priority areas. The WHO highlighted the aim of this cluster as "the research community overarching aim is to bring social science technical expertise to integrate with biomedical understandings of the COVID-19 epidemic, to strengthen the response at international, regional, national and local levels in order to stop the spread of COVID-19 and mitigate its social and economic impacts". The global roadmap also outlined three objectives under this priority area: understanding contextual vulnerability, how decisions in the field may inadvertently undermine response goals, and how social and economic impacts need to be mitigated. However, the research on different aspects of social science, particularly in economics, remains significantly lower.

The dominance of medical and clinical research on different pandemics and epidemics, including the COVID-19 pandemic, is supported by substantial literature review papers, including the bibliometric study.

* Corresponding author. Department of Finance and Banking, Faculty of Business and Accountancy, University of Malaya, Malaysia.
E-mail addresses: masnunmahi@um.edu.my (M. Mahi), mobin@ifintell.org (M.A. Mobin), marziahabib@hotmail.com (M. Habib), shabihaakter@sd.taylors.edu.my (S. Akter).

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From the methodological standpoint of this study, we find that most bibliometric studies regarding epidemic and pandemic focus on medical and clinical research; COVID-19 related studies are not an exception. The method is widely used in medical research (Liao et al., 2018; Liu et al., 2020), public health (Cash-Gibson et al., 2018; Humboldt-Dachroeden et al., 2020; Kalita et al., 2015; Tran et al., 2019), and particularly to review the literature related to infectious disease and virology research (Azer, 2015; Hendrix, 2008; Ramos et al., 2004; Yang et al., 2020a). Moreover, the earlier researchers conducted such bibliometric studies to review literature that focuses on infectious diseases like influenza (Liang et al., 2018) or HIV (Macías-Chapula & Mijangos-Nolasco, 2002; Sweileh, 2019). A significant amount of research has been conducted on Coronavirus and related diseases like Ebola, severe acute respiratory syndrome coronavirus (SARS), Middle East Respiratory Syndrome coronavirus (MERS) (Deng et al., 2020; Ram, 2020; Sa'ed, 2016; Kostoff & Morse, 2011). Notably, a substantial increase in such studies is found after the outbreak of COVID-19 (Chen et al., 2020; Danesh & GhaviDel, 2020; Dehghanbanadaki et al., 2020; El Mohadab et al., 2020; Wang & Hong, 2020; Yang et al., 2020b). However, to the best of our knowledge, there is no previous bibliometric review that comprehensively studies the coronavirus and epidemic literature in economics. Hence, this study makes a humble effort to analyze existing literature in the field of economics on COVID-19 and the earlier variants of the Coronavirus. Moreover, we essentially integrate the research on the virus and virus-induced epidemics and pandemics in our study. Given the backdrop of economic consequences brought by the latest COVID-19 pandemic, the study aims to analyze the published scientific works that focus explicitly in economics and related issues. Hence, in this study, we substantively provide a review of literature from the past to present in quantitative terms and make a humble attempt to visualize the prevailing knowledge structure to help future researchers and policy makers.

To achieve the objectives, we come up with specific research questions listed below:

1. Who are the top researchers, and what are the leading journals, institutions, and countries investigating the economic aspects of pandemic or epidemic?
2. Is there an existence of geographical concentration, and how is the interconnectedness of research?
3. What are the top keywords and the related prominent research clusters?
4. How are the progression of research in the field of economics and the relative changes during different infectious disease outbreaks?

Using the bibliometric method, our study provides a comprehensive summary of Coronavirus, epidemic, and pandemic literature published over more than 47 years in the field of Economics. The analysis effectively considers 1,636 scientific publications in this period that are listed in the Web of Science (WoS) database. We try to show all existing scientific research patterns in a specific field of study to achieve the objectives. In general, we have found an increasing trend in publications since 2002 that coincides with the outbreak of SARS; however, the steady growth in publications experienced a rapid upswing during 2020 since the inception of COVID-19. Besides identifying the most contributing and influential authors, publication sources, research institutions, and countries, we provide several visualizations to comprehend the findings in a more precise way like the publication dynamics of the top publishing sources, country collaboration map as well as the interconnection between institution, country, and publication sources. Such findings help us finding out the research concentration at different levels (i.e., geographic intensity or nature of collaboration).

Furthermore, we analyze the conceptual structure of research through the correspondence analysis of keywords to understand the most prominent research clusters. We notice a distinct and significant research cluster that focuses on 'economic growth,' 'risk', 'income', 'demand', 'consumption,' and 'growth.' Even we find that importance is also given to the issues like 'policy,' 'cost-effectiveness', 'strategies' or 'management' aspects and that creates a related yet distinct cluster of research. Moreover, we consider different infectious disease outbreaks during the analysis period to see the changes in knowledge structure. We observe that 'HIV' is the leading disease in different periods, even during the other outbreaks like the SARS coronavirus, the Middle East respiratory syndrome coronavirus (MERS), and Ebola. The findings indicate that there is a lack of research in the field of economics and related business aspects that directly address the impact of Coronavirus. Studies have emphasized 'cost-effectiveness' when studying the risk or impact of health crises in recent years. Our research shows the potential avenues to explore for the researchers who intend to study different economic aspects of the current COVID-19 pandemic. Hence, we contribute to the literature by highlighting other characteristics of existing research and knowledge structure through reviewing publications over 47 years. Furthermore, a wide range of indicators offers potential areas that future research can explore.

The remainder of the paper is set out as follows: Section 2 discusses the study's methodological aspects, which briefly explains the indicators and performance metrics of the bibliometric studies to evaluate the scientific outputs. Additionally, this section provides the rationale for employing the chosen data sources and analytic tools. Section 3 presents and discusses the key findings to understand the scientific output in this research area. Section 4 summarizes the findings, outlines the research gaps, and suggests future research areas to conclude the study.

2. Data and methodology

As quoted in Akhavan et al. (2016) and referred to Ponce & Lozano (2010), "Bibliometric analysis refers to combining different frameworks, tools, and methods to study and analyze citations of scholarly publications has led to the development of different metrics to gain insights into the intellectual structure of broad academic discipline and evaluate the impact of scientific journals, studies, and researchers accordingly." In the current study, we use bibliometric analysis to review the literature of interest as this method helps us analyze the existing publications objectively (Ellegaard & Wallin, 2015), and compared to other methods of literature review, bibliometric is a systematic, straightforward, and reproducible process that minimizes the intrinsic subjectivity of narrative and systematic reviews (Della Corte et al., 2019). Besides, visualizing the bibliographic information through mapping allows scholars to understand research trends broadly and intuitively by highlighting the boundaries of the existing relevant intellectual territory and knowledge structure (Cobo et al., 2011). To perform a bibliometric review of the relevant literature, we used a five-step procedure proposed by (Zupic & Čater, 2015). The workflow of the five-step process is presented in Fig. 1 below:

To answer the research questions, we use several bibliometric indicators and science mapping techniques. We employ citation analysis to measure authors' and publications' impact as this is the most conventional measure to assess the scientific quality and impact (Waltman et al., 2012). In essence, a high citation indicates the high impact of a particular author or document in a specific field of study (Feng et al., 2017). Another comparable impact analysis measurement is the h-index, which measures the productivity and influence of an author or a publication source through integrating the quality and quantity - 'h' number of articles published by an author is cited at least 'h' times each (Hirsch, 2010). Besides, we make use of Lotka's Law to measure the frequency of publications by authors, which determines the productivity patterns in a given field of study over a specified period, allows concluding whether the analyzed area is one in which most of the production is concentrated in a limited number of authors or not (López-Fernández et al., 2016). Similarly, we determine the core journals through Bradford's Law that enlists the journals ascendingly with the highest frequency of publications are ranked as 'core zone' and so on. This method is often used to

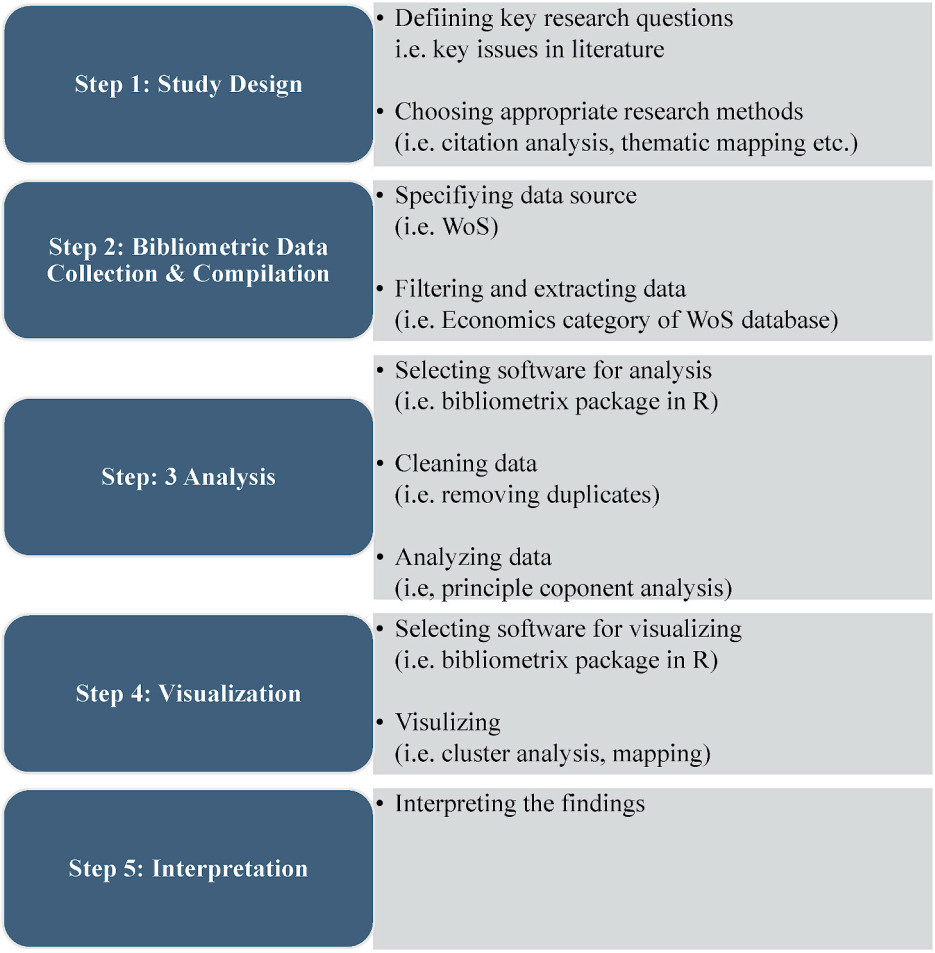

Fig. 1. Workflow of bibliometric analysis.

understand how the literature on a particular subject is scattered or distributed in the journals and used as a guideline to determine the number of core journals within a given subject (Garg & Tripathi, 2018). Besides, we utilize the number of publications and citations information to find out the most influential country and institutions as well as visualize to illustrate the geographic and institutional leadership of the research.

Moreover, we use keywords and co-words analysis to map this field of research's existing knowledge structure. This analysis is a systematic method for scientifically discovering subfield linkages, tracking the phenomenon (Feng et al., 2017), and building a semantic field map (Zupic & Čater, 2015). Whereas, co-word analysis helps us use the actual content of a text directly to capture co-occurrence interactions in constructing the framework (Feng et al., 2017); hence, to extract scientific maps derived based on the high frequencies of words that appear in the text. Using the appropriate clustering algorithm (i.e., Multiple Correspondence Analysis or MCA) of keywords, we present the existing research's conceptual structure and thematic map. The MCA analysis draws a conceptual design of the field and K-means clustering to recognize groups of documents that express common concepts (Aria & Cuccurullo, 2017) and identify the structure of existing research clusters by measuring the proximity of keywords used in the research (Demiroz & Haase, 2019).

To analyze the bibliographic information to answer the specified research questions, we consider the Web of Science (WoS) database to perform the bibliometric analysis. The WoS is a well-known database and incorporates all the information with more than 161 million records across 254 subject areas.[1] The database gives access to articles from scientific journals, books, and other academic documents in all disciplines to the scholarly community. Though WoS does not essentially index the largest number of journals in all the different fields compared to other databases like Scopus (Li et al., 2010), it is believed to provide an adequate amount of high-quality literature (Ellegaard & Wallin, 2015). To obtain a representative amount of bibliographic information from the WoS database, we have considered the following search strings.

TOPIC: ("Virus*" OR "Pandemic*" OR "Epidemic*" OR "Corona virus" OR "Coronavirus" OR "SARS" OR "MERS" OR "severe acute respiratory syndrome" OR "Middle East Respiratory Syndrome")

As we are interested in the historical nature of research and publications, hence we have considered the keywords like 'Virus,' 'Pandemic,' 'Epidemic' as well as the 'Coronavirus' and 'Corona virus' to get a more extensive coverage and to find out potential areas for future studies on COVID-19. Besides, we have included the keywords like 'SARS,' 'MERS,' 'severe acute respiratory syndrome' and 'Middle East Respiratory Syndrome' since it represents the historical alliance with COVID-19. Moreover, we refine our query results with the 'Economics' category of WoS, which allows us to focus on the publications that consider different aspects of the economic implications of the keywords

[1] Clarivate Analytics Company (Web of Science Group) Website: https://clarivate.com/webofsciencegroup/solutions/web-of-science/; accessed on February 14, 2020.

considered. Finally, to analyze and visualize, we use the 'Bibliometrix' package (http://www.bibliometrix.org) developed by Aria & Cuccurullo (2017) in R (an open-source statistical application) to perform the analysis. The Bibliometrix package is well-known for its wide range of features and is used in a growing number of publications (Firdaus et al., 2019; Linnenluecke et al., 2020).

3. Analysis, visualization, and discussion

3.1. Key information and trends in publications

After careful filtering and cleaning of retrieved data from the WoS database, we obtain a total of 1636 scientific documents to analyze. We present the key characteristics of data in Table 1 below:

From Table 1, we find that the earliest publication listed on pandemic related studies in the field of economics dates back to 1974, whereas some of the publications are already assigned to be published in 2021. Hence, our analysis comprehensively captures publication information of more than 47 years. However, the number of publications in the field of economics is not significant considering the long period. Yet, the publications have experienced steady growth over the year, as presented in Fig. 2. This trend graph indicates a small increase in the number of publications since 2002 compared to earlier years. Conceivably, the outbreaks of severe acute respiratory syndrome coronavirus (SARS-CoV) in 2002 in China spurred the increased interest in this research area. Besides, we notice a slight rise in publications from 2012 onwards, possibly due to the similar coronavirus outbreaks in Middle Eastern countries termed as the Middle East Respiratory Syndrome coronavirus (MERS-CoV). However, we observe a massive shift of publications in recent years (i.e., the year 2020) compared to earlier years. The rapid rise in publication plausibly indicates that the research on COVID-19 has prompted a substantial interest in the scholarly community, even in the field of economics.

Moreover, we notice that a total of 4,596 authors have contributed to the publications so far, and their scientific works are published by 393 publication sources in the form of journal article, review, book chapter, proceedings paper, editorial materials, and so on. However, most of the published documents are in the form of journal articles, and it consists of around 64.70% (1,059 out of 1,636), including the early access publications. The authors have used 46,028 references and 2,936 different keywords in their research over time. Most of the scientific publications are collaborative in nature as only 355 publications of the total are single-authored, and each of the documents received around 11 citations, on average. In the following subsections, we analyze and visualize different characteristics of these documents to uncover existing knowledge composition in this field of study.

Table 1
Sample descriptions.

Description	Results
Timespan	1974–2021
Documents	1636
Publication Sources (Journals, Books, etc.)	393
Authors	4596
Authors of single-authored documents	355
Authors of multi-authored documents	4241
Average citations per documents	11.21
References	46028
Author's Keywords	2936
DOCUMENT TYPES	
Article	1000
Article; early access	59
Article; proceedings paper	32
Article; book chapter	41
Book review	24
Discussion	1
Editorial material	30
Editorial material; book chapter	6
Letter	6
Meeting abstract	274
Note	5
Proceedings paper	104
Review	52
Review; early access	2

3.2. Most contributing authors and publication sources

In this section, we present the top contributors to knowledge in Coronavirus and related research in Economics. Initially, we present the authors' publication outputs through Lotka's Law of scientific productivity in Fig. 3.

Lotka's Law allows us to conclude whether the analyzed area is one in which most of the production is concentrated in a limited number of authors or not (López-Fernández et al., 2016). In our case, the output is diversified, with many authors (3,972 out of 4,596) having only one publication, which accounts for 86.42% of the total contributing authors. The distribution essentially indicates that scientific publications' contributions are not distributed to a few authors but diversified to the number of authors. However, from the perspective of publication sources, we find that only four journals have positioned themselves as the core publishing sources in this area, according to Bradford's Law. As depicted in Fig. 4, Value in Health, Pharmacoeconomics, World Development, and Health Economics are the core journals that have major influences in publications than other journals in the field.

Accordingly, we present the 20 most publishing authors and journals along with their number of total publications (NP), total citations (TC), and corresponding h-index values to understand the productivity as well as the impact of their publications in Table 2.

Considering the number of scientific outputs, Baser O. is the most prolific, having published a total of 13 scientific documents, followed by Yuan Y., who has published 11. However, author dominance is not consistent across different indicators. The next most publishing authors, both Mitchell I. and Wang L., have published ten papers while Lanctot K. L. & Li A. have published nine each; however, they have not received any citation until now. Considering the impact of publication in terms of total citations (TC) and h-index, Beutels P. is the top-ranked author with 272 citations and an h-index of 6, followed by Philipson T.J., who has received a total of 148 citations with an h-index value of 5. Postma M.J., Mcewan P., and Laxminarayan R. are among the other influential contributors in this area of research in terms of citations received for their scientific publications and respective h-index value.

Besides, in Table 2, we list down the top 20 publication outlets and the core journals presented earlier for the authors to publish scientific documents. Value in Health is the most publishing journal compared to its peers. The journal has published 347 scientific documents to date, which is significantly higher than Pharmacoeconomics has 113 publications on the related topics. However, the ranking alters if we consider the TC and h-index. Though Value in Health journal is the most prolific in terms of publications, Pharmacoeconomics positions itself as the most impactful journal, having received a total citation of 3019, which is more than two and half times higher than the citations received by Value in Health. Similarly, the h-index value of Pharmacoeconomics is 29, which is significantly higher than Value in Health. Besides, the other two core journals in the list, namely, World Development and Health Economics, have published 50 and 39 articles and received 244 and 700 citations, respectively. Considering the discrepancy in the number of publications with citations received by the top journals, we further illustrate the core sources' annual publication dynamics in Fig. 5.

Fig. 5 shows an increasing publication trend for almost all the top journals in this research field of different magnitude. Interestingly, the sharp rise of publications by the Value in Health journal started around the 2000s, surpassing Pharmacoeconomics by 2004. They have published a significantly higher amount of scientific outputs until recently. Although Pharmacoeconomics shows a decreasing trend in publishing articles in this particular field, other top journals show a small but

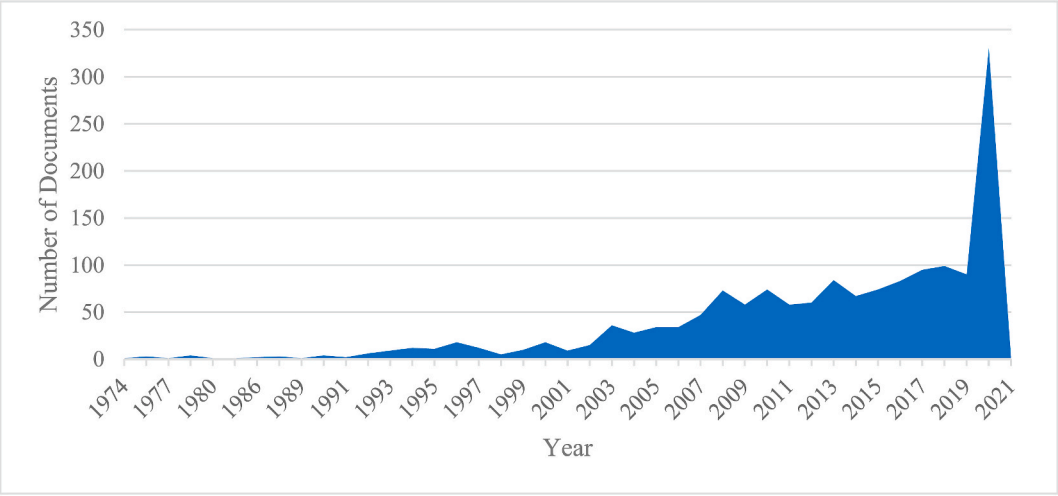

Fig. 2. Annual publications trend.

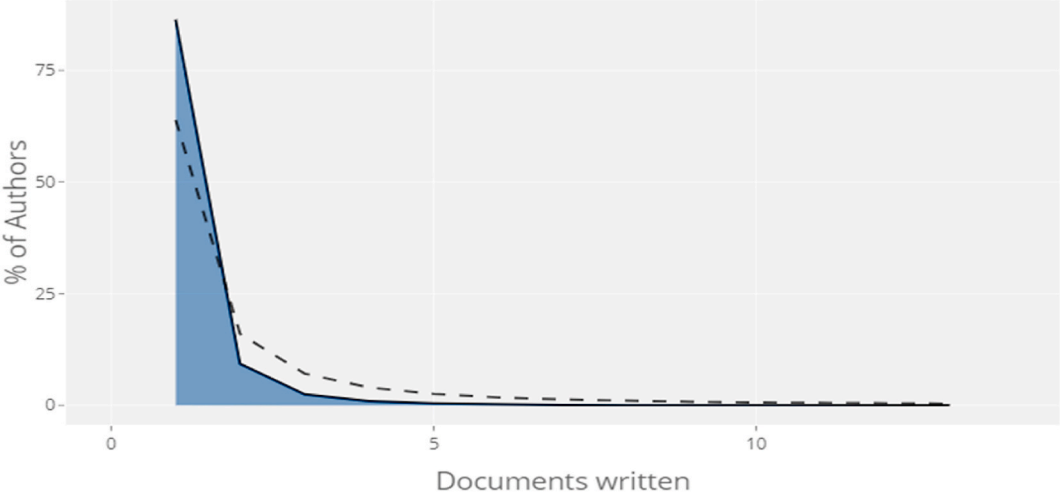

Fig. 3. Frequency distribution of publications through Lotka's law.

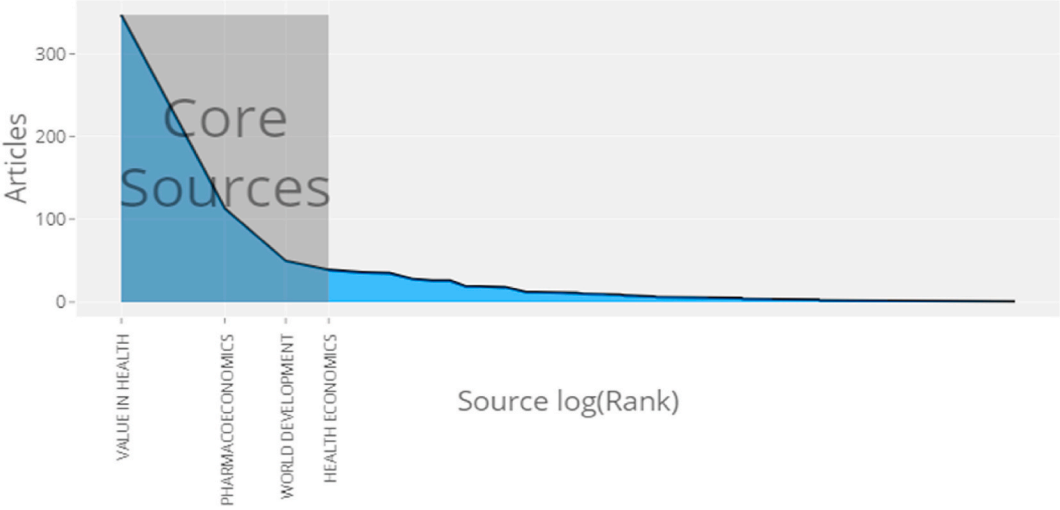

Fig. 4. Bradford's law of source clustering.

Table 2
Most contributing authors and publication sources.

Most Contributing Authors					Most Contributing Publication Sources			
Rank	Author	NP	TC	h_index	Source	NP	TC	h_index
1.	Baser O	13	1	1	Value in Health	347	1140	20
2.	Yuan Y	11	80	3	Pharmacoeconomics	113	3019	29
3.	Mitchell I	10	0	0	World Development	50	244	8
4.	Wang L	10	0	0	Health Economics	39	700	15
5.	Lanctot KL	9	0	0	Environmental & Resource Economics	36	90	4
6.	Li A	9	0	0	Journal of Health Economics	35	936	17
7.	Postma MJ	9	132	4	Economics & Human Biology	28	576	12
8.	Vickerman P	7	11	2	European Journal of Health Economics	26	242	8
9.	Finnoff D	7	46	4	Tijdschrift Voor Economische En Sociale Geografie	26	41	2
10.	Mcewan P	7	56	3	Canadian Journal Of Agricultural Economics-Revue Canadienne D Agroeconomie	19	87	5
11.	Paes BA	7	0	0	Emerging Markets Finance and Trade	19	26	2
12.	Beutels P	6	272	6	Applied Economics	18	63	4
13.	Cicchetti A	6	37	3	Applied Health Economics and Health Policy	18	75	6
14.	Kariburyo MF	6	1	1	Economic History Review	15	113	5
15.	Laxminarayan R	6	49	4	American Journal of Agricultural Economics	12	197	9
16.	Mitra D	6	26	1	Applied Economics Letters	12	4	1
17.	Park H	6	3	1	Canadian Public Policy-Analyze De Politiques	12	91	5
18.	Philipson TJ	6	148	5	Food Policy	12	321	7
19.	Ruggeri M	6	37	3	South African Journal of Economics	12	97	5
20.	Ward T	6	14	2	Futures	11	138	6

NP: Number of Publications; TC: Total Citations.

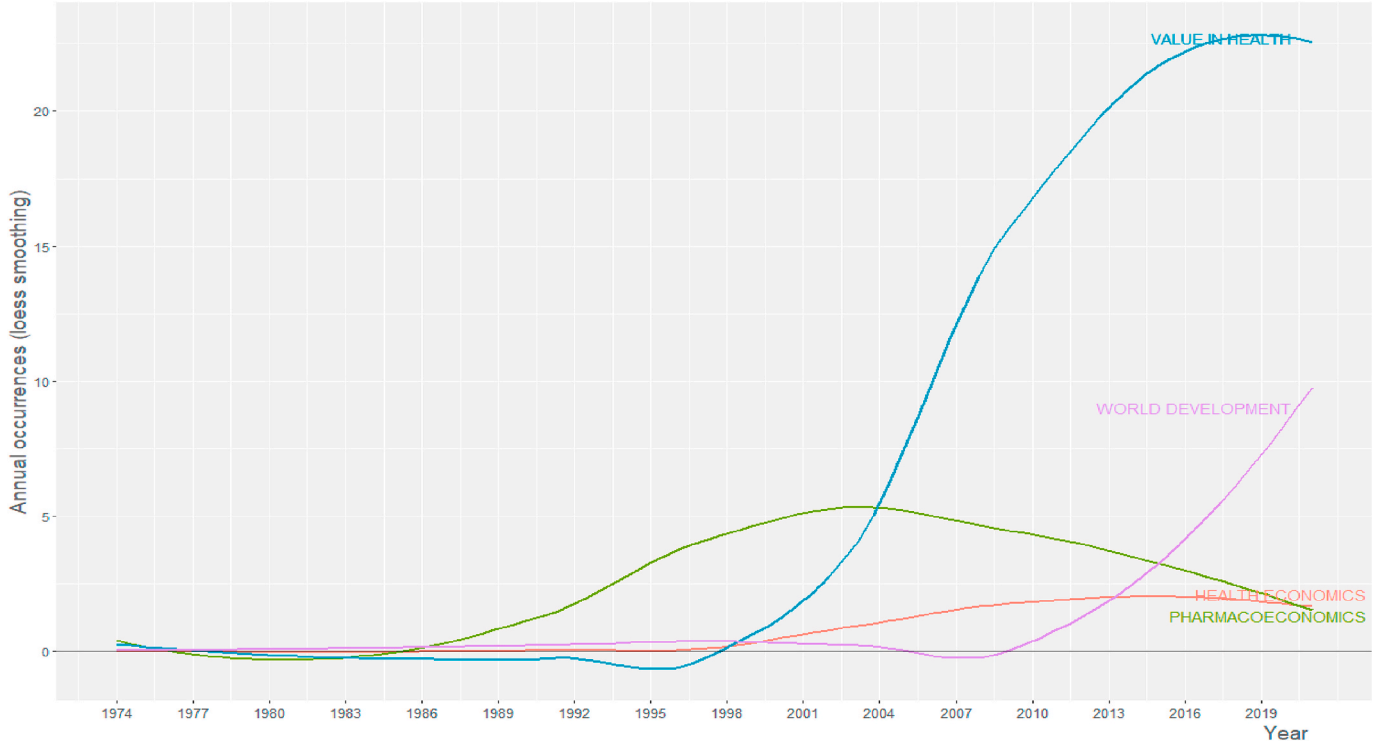

Fig. 5. Annual growth of core publication sources.

increasing trend in publications in this area. One possible reason that Pharmacoeconomics has received a significantly higher number of citations could stem from the journal's dominance in the earlier years. Perhaps, the seminal papers in this field have received a considerable amount of citations by the subsequent publications in the later periods. Altogether, the trend indicates an augmented interest by the journals to publish articles that consider the economic aspects of the issues. Interestingly, the rising trends in publications by the top publication sources coincides with the inception of the overall upward trending publications, as depicted in Fig. 2. Therefore, authors may consider the analysis and illustrations useful to find the right publication outlets more efficiently to publish their latest scientific outputs, especially the research on COVID-19 that covers different economic aspects.

3.3. Geographic and institutional distribution of research

This section analyzes the geographic distribution of publications taking into account authors' affiliated institutions and countries. Table 3 shows the most productive institutions and countries in terms of total publications. Also, it presents the collaborative nature of the scientific outputs of the leading countries through multi-country publications (MCP) and multi-country publication ratio (MCPR).

At the institutional level, we observe a significant dominance of the universities and research institutions from the US. Authors affiliated

Table 3
Most contributing institutions and countries.

Most Contributing Institutions			Most Contributing Countries					
Rank	Affiliations	NP	Rank	Country	NP	SCP	MCP	MCPR
1.	Univ Michigan	35	1.	US	542	433	109	0.2011
2.	Univ Chicago	34	2.	UK	153	104	49	0.3203
3.	Univ Oxford	34	3.	China	122	94	28	0.2295
4.	Univ Toronto	27	4.	Canada	71	57	14	0.1972
5.	Harvard Univ	26	5.	Australia	53	37	16	0.3019
6.	Res Triangle Pk	26	6.	Germany	52	33	19	0.3654
7.	Statinmed Res	22	7.	Netherlands	37	27	10	0.2703
8.	Univ Groningen	22	8.	France	35	29	6	0.1714
9	Univ Cambridge	21	9.	Italy	33	25	8	0.2424
10	Johns Hopkins Univ	18	10.	Spain	24	17	7	0.2917
11	Mcmaster Univ	18	11.	South Africa	22	16	6	0.2727
12	Stanford Univ	18	12.	Belgium	19	7	12	0.6316
13.	Univ Washington	18	13.	Russia	19	17	2	0.1053
14	Univ British Columbia	17	14.	Switzerland	17	10	7	0.4118
15.	Univ N Carolina	17	15.	India	16	14	2	0.125
16.	Australian Natl Univ	16	16.	Korea	12	11	1	0.0833
17.	Columbia Univ	16	17.	Sweden	12	9	3	0.25
18.	Cornell Univ	16	18.	Japan	11	6	5	0.4545
19.	London Sch Hyg And Trop Med	16	19.	Poland	10	9	1	0.1
20	Univ Calgary	15	20.	Austria	9	2	7	0.7778

NP: Number of Publications; SCP: Single Country Publications; MCP: Multiple Country Publications; MCPR: Multiple Country Publications Ratio.

with the University of Michigan (Univ Michigan) have published the most articles in this field (NP = 35), closely followed by the University of Chicago (Univ Chicago), having contributed to 34 scientific publications thus far. Noteworthy contributions in this field are received by North Carolina State University, Duke University, and the University of North Carolina at Chapel Hill, represented by Res Triangle Pk (or Research Triangle Park) representing the collaborative research activities the stated universities having published 26 scientific documents collectively. Among the other institutions from the North American region, authors from the University of Toronto (Univ Toronto) have made notable contributions and published 27 scientific publications, followed by McMaster University (Mcmaster Univ). On the other hand, the University of Oxford (Univ Oxford) and the University of Cambridge (Univ Cambridge) are the most publishing universities from the UK, contributing to 34 and 21 scientific publications. Australian National University (Australian Natl Univ) is the only institution in the list other than the American and European universities, which has made 16 scientific publications.

Alike, at the country level, the US is the most productive country in this field of research (NP = 542), followed by the UK (NP = 153) and China (NP = 122). However, the UK has a superior collaborative publication output compared to other top publishing countries on the list, having an MCPR of 0.3203 among the top three. The ratio indicates that almost one-third of all publications by UK authors collaborate with the

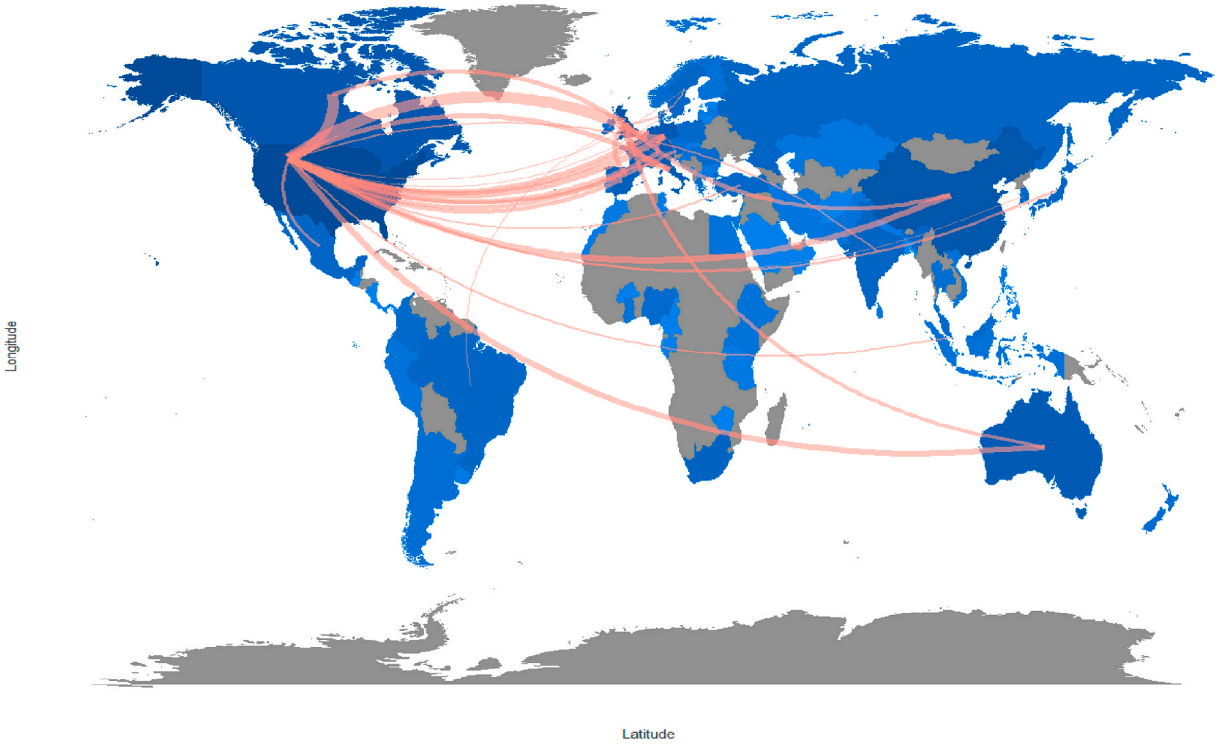

Fig. 6. Collaborations world map.

researcher from other countries. However, the rate is aced by other countries like Austria, Belgium, Japan, Switzerland, and Germany, having MCPR value of 0.7778, 0.6316, 0.4545, 0.4118, and 0.3654, respectively. Overall, the collaborative research trend is higher for most of the European countries on the list.

The country scientific production and collaborative networks are illustrated in Fig. 6. The blue color on the map indicates the existence of publications for a particular country on the issues under analysis, and the color grey indicates no journal. The states with darker blue color represent more publishing countries while the red lines indicate the publishing countries' collaboration networks.

The countries that were collaborating most actively are the US and the UK. Being the most publishing countries, authors from both countries have a high collaborative scientific output. Other countries that the US authors are collaborated with include Canada, Germany and China; whereas the UK researchers collaborated with researchers from Italy, Germany, and Belgium besides the US. On the other hand, China has collaborative research outputs with Germany, Singapore, and Australia mostly. The findings indicate that most of the research outputs are dominated by researchers from developed countries. There is an existence of regional concentration in terms of the collaboration of research activities.

We encapsulate the top 10 prolific countries and institutions with the top 10 publishing sources through a three-field plot in Fig. 7. This Figure provides us with the idea of the institutions' relative contributions to a country's overall research output.

For the US, almost all the top research institutions and universities presented earlier have significant contributions to overall country publications. However, the scenario is relatively different for the UK, where the University of Oxford has contributed the most in overall country scientific production; a notable contribution is made by the University of Cambridge. Interestingly, for China, we do not notice any specific institution's dominance in scientific productions; instead, the publications are distributed among the institutions and indicate the diversity of institutional contributions in the total number counts at the national level. At the same time, some countries like Canada and the Netherlands received their significant contributions from a single institution, correspondingly from the University of Toronto and the University of Groningen. From the publication sources perspective, the highest publishing journal Value in Health is mostly contributed by the authors from the US and the UK, along with China, Canada, the Netherlands, and Italy. Publications in other sources are distributed randomly among different top publishing countries.

3.4. Keywords analysis and thematic analysis of research

This section provides the research keywords used by the authors in Coronavirus related research over time. Statistical analysis of author keywords can offer research directions, which can be a useful way to delve into scientific output development (Du et al., 2013). This section also discusses different research clusters in which the studies are concentrated mostly through the co-occurrence of keywords and research dynamics. Besides, we explain the shifts in research focus by uncovering the research themes at different points in time.

We list down the 30 most frequently used keywords in the publications and illustrate the relative occurrences in a Word TreeMap in Fig. 8. The words 'impact', 'health' and 'united states' are used most frequently along with 'epidemic.' Other most commonly used keywords are 'mortality' and 'risk' among the top 5 words. In incoherence with earlier findings, we also identify the geographical concentrations of research, recognizing the significant occurrences of the keyword 'united states.' Though we do not consider these keywords in isolation in our search strings, assuming it would dilute our focus; still, the appearance of such words indicates a strong geographic concentration of the research outputs.

We then use the keywords used in the research by the authors conducted the Multiple Correspondence Analysis (MCA) to find out the conceptual structure of research. Using the method, we identify the major research clusters in our area of interest. The two-dimensional plot of research clusters is presented in Fig. 9. The graph indicates that the scientific outputs considered in our study can be organized into five primary clusters, which signify the intellectual structure of research

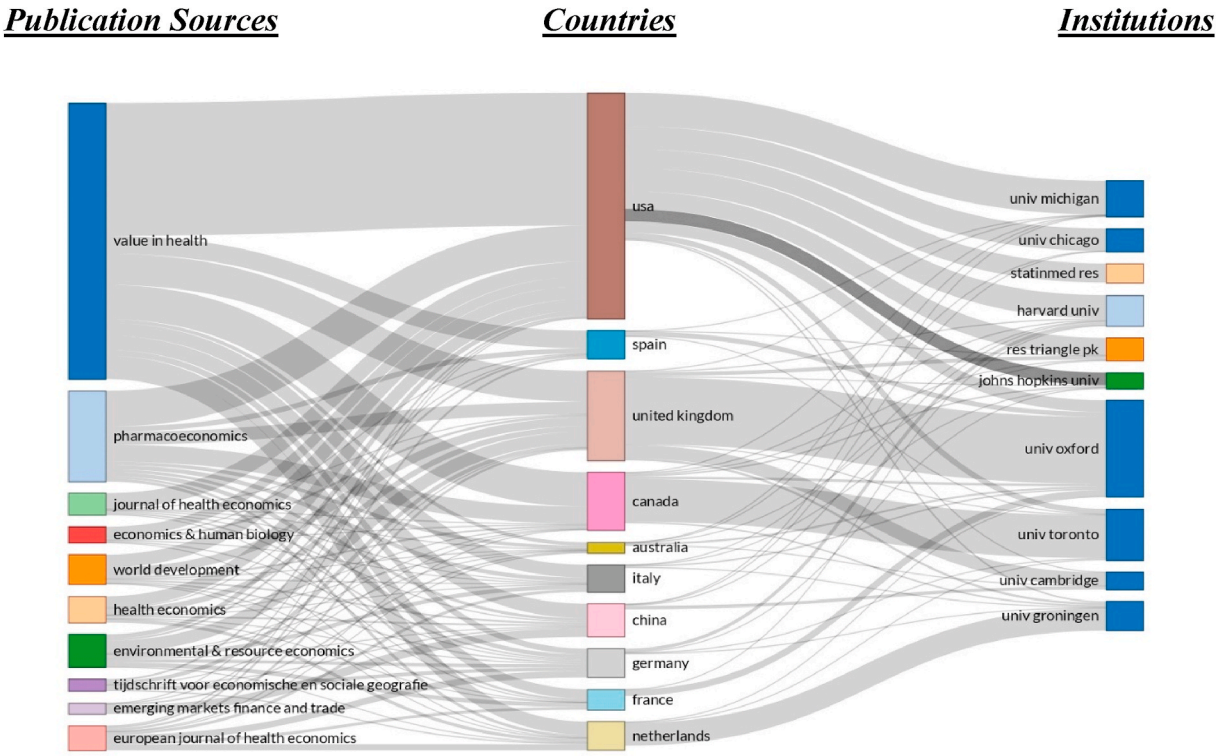

Fig. 7. Three-field plot of top publication sources, countries & institutions.

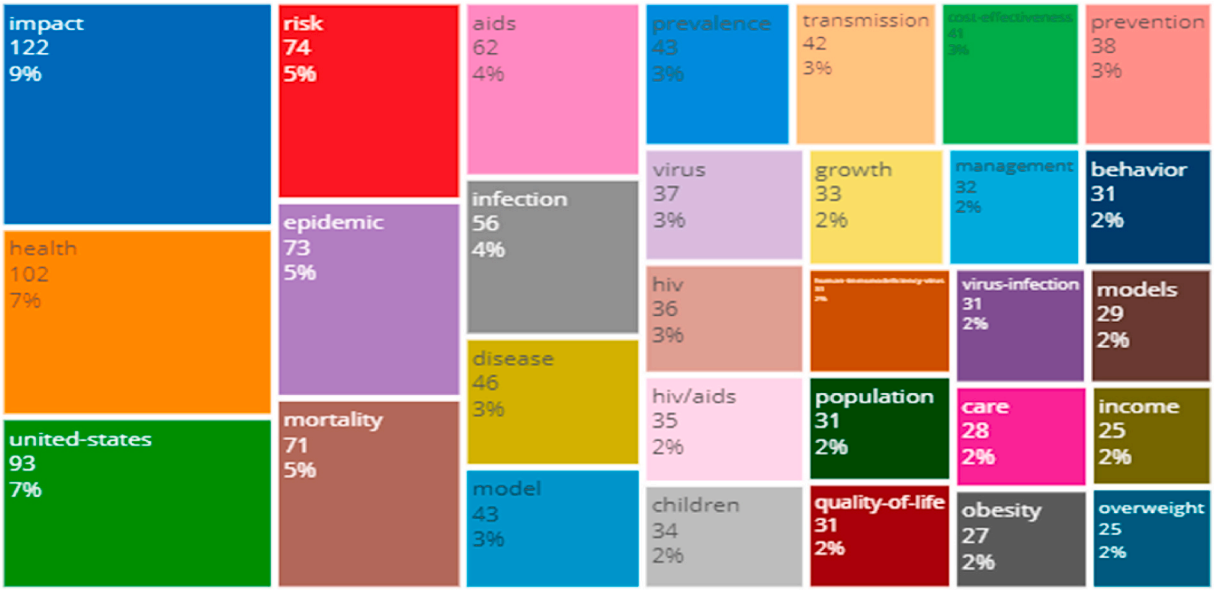

Fig. 8. Word tree map of author keywords.

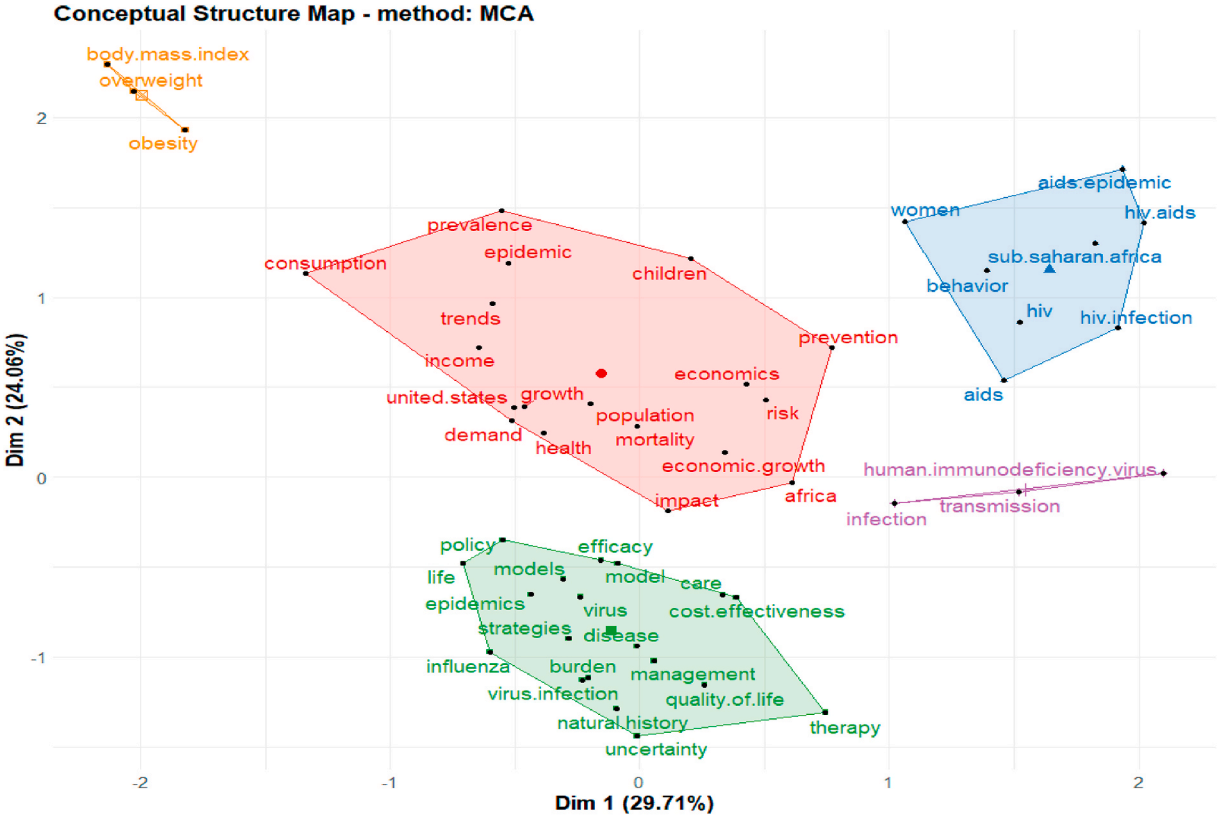

Fig. 9. Conceptual research structure.

issues addressed by the scholars who concentrate on the related aspects. While a comprehensive review of these five clusters' content is beyond the scope of this article, a few illustrative examples demonstrate the diversity, breadth, and intellectual thrust of the work undertaken in each cluster.

The first cluster (color: red) contains a total of eighteen keywords associated with articles that emphasize the 'epidemic.' We notice that studies have focused on different aspects of economics as noticeable through 'economics' and 'economic growth.' Besides, we find the research highlights other aspects of Economics like 'income,' 'demand,' 'consumption,' 'growth' and the like besides the health-related aspect. The findings suggest that research on epidemic or pandemic relate studies tend to see the impact on different aspects of economic welfare – how the income, consumption, or related aspects are affected during such periods of uncertainty are major research interests in economics. Similarly, the second large research cluster identified and colored in green shows the importance is also given on the issues like 'policy,' 'cost-effectiveness,' 'strategies' or 'management' aspects. The diagram shows

that such research issues have more connection with 'care,' 'efficacy,' 'burden,' or 'quality of life.' We comprehend that the research community has focused on the different business and management related aspects of 'virus infection,' 'therapy' or 'models.' Hence, the cluster indicates a niche focus area of research that carry particular significance during pandemics or epidemics.

In these major two research clusters, the concentration is also given to the demographic and geographic vulnerability of the community, which are represented by the keywords such as 'population', 'women,' 'children,' and 'Africa.' However, we notice two distinct research clusters (color: blue and violet) constitute unique research areas that focus on the 'sub-Saharan Africa' and the spread of 'Human immunodeficiency virus' or 'HIV.' However, we do not find any dominant aspects on economics in these research clusters as no such keywords are apparently visible. Perhaps, the publications are multidisciplinary in nature and listed under the economics category too in the WoS database. The authors highlighted the African regions' economic vulnerability in their research instead of focusing on any particular economic characteristic of such disease or transmission. Similarly, the fifth cluster publications (color: yellow) do not depict such an association of financial issues.

Furthermore, we attempt to identify the most significant research areas, how the topics have evolved and fused, and the most recent research issues by breaking down the entire research period into four different periods. We have used the inclusion index weighted by word occurrences, with each cluster contains 250 author keywords. Fig. 10 illustrates the research clusters for varying periods. The time slice represents the most prolonged period spanning from the initial year 1974–2002. We have chosen 2002 as the cut-off year since the SARS coronavirus virus was identified in 2003.[2] Therefore, we wanted to look at the research concentration for the SARS outbreak. Similarly, we have chosen 2011 as the second breakpoint, considering the Middle East respiratory syndrome coronavirus outbreak in Saudi Arabia and other Middle East countries in 2012.[3] Moreover, we believe the Ebola virus outbreak in African countries in early 2014 was first reported in Guinea by WHO[4] since it falls within our analysis period. The rest of the periods represent the most recent development of research starting from 2015 to the present. Analyzing research development helps us understand the consistency and changes of focus in research due to different pandemic or epidemics. Besides, the analysis allows us to track the historical development and the latest changes in the research concentration in the field of interest.

From Fig. 10, we notice the research on AIDS and related areas have cut the most attention of the study over time and remained dominant as late as 2014. This indicates a lack of focus given to the other virus-related epidemic or pandemic, especially on Coronavirus. We have included the keywords to apprehend the studies related to Coronavirus, and associated outbreak periods are chosen. Still, we fail to distinguish distinctive research clusters at different times.

Even though the research is dominated mostly by the generic aspects of the disease, we still identify economic issues in the publications. Significantly, the emergence of such problems is more in recent times. We notice a significant development of the research focus on the topics like 'cost-effectiveness.' Through tracking back to an earlier period (2012–2014), we find that the research on 'cost-effectiveness' essentially connected with 'impact,' 'united states' and 'epidemic.' The illustration highlights that a significant focus has been given to the cost-effectiveness in dealing epidemic and their impact. Presumably, this particular aspect of pandemic-epidemic economic studies is very relevant to the COVID-19 crisis as it has substantial economic consequences due to lockdown policies. Lockdown prescription is working for COVID-19 infection control but crashing the financial system. As a result, to save the economy, governments are announcing stimulus packages, reducing the portion of health investment. Thus, the cost-effectiveness study becomes crucial in this scenario. However, the other aspects of economics evident in the cluster analysis in the previous section do not segregate the examination in different periods. The findings imply that economics aspects have been given importance to a certain extent; however, the critical matter is still lacking.

4. Conclusion

4.1. Summary of the findings

This paper traces the publications on epidemic and pandemic studies in economics since 1974. We reviewed a total of 1,636, which are indexed in the WoS database under the economics category. Our analysis has reported major aspects of research in this field, including most influential publications, journals, authors, institutional affiliations, and geographic diversity or concentration. We have further analyzed the most relevant keywords in this area of research, their conceptual construction, and the research dynamics to comprehend historical evolution to the most recent development. Accordingly, we answer the research questions specified in the Introduction section of this study. The major findings are summarized according to the research questions as follows:

4.1.1. Who are the top researchers, and what are the leading journals, institutions, and countries investigating the economic aspects of pandemic or epidemic?

By analyzing the relevant literature's bibliometric information, we find that Baser O is the most publishing author, having published 13 scientific documents among 4,596 authors. However, Beutels P appeared as the most impactful authors in terms of total citations received and h-index. As a publication source, Value in Health is ranked as the most publishing journal but not the most impactful one. Value in Health journal published 347 scientific works during the analysis period, and their published documents are cited 1,140 times, which is considerably lower than the second most publishing journal Pharmacoeconomics. The latter got total citations of 3,019 for its 113 publications and possesses the h-index value of 29, which is the highest among all the top listed publication sources. Comparably, the US is the most productive country in terms of the number of publications. The authors affiliated with the US universities and research institutions are ranked as the most contributing one in economics, topped by the University of Michigan.

4.1.2. Is there an existence of geographical concentration, and how is the interconnectedness of research?

Considering the importance of the distribution of knowledge, we further analyze, rank, and illustrate the degree and nature of collaboration. We find that the US has the highest number of collaborative publications with higher collaboration with countries like Canada, Germany, and China. However, the ratio of such collaboration compared to the total publications is relatively low than the other top producing countries in the list. In essence, the UK has a higher collaboration rate and sizable publications, and their collaborations are predominantly with the other European countries like Italy, Germany, or Belgium. In contrast, China has comparatively diverse collaborative research outputs with its most active collaborating partners from Germany, Singapore, and Australia. The findings indicate that researchers from developed countries dominate the publications, and there is an existence of regional concentration in terms of the collaboration of research activities, at least in part. Using a three-field plot, we further illustrate the nature of interrelation among the top journals, countries, and institutions. We find that for some countries, the overall country-specific

[2] World Health Organization Website (Accessible at: https://www.who.int/ith/diseases/sars/en/).

[3] World Health Organization Website (Accessible at: https://www.who.int/news-room/fact-sheets/detail/middle-east-respiratory-syndrome-coronavirus-(mers-cov)).

[4] Centers for Disease Control and Prevention Website (Accessible at: https://www.cdc.gov/vhf/ebola/history/2014-2016-outbreak/index.html).

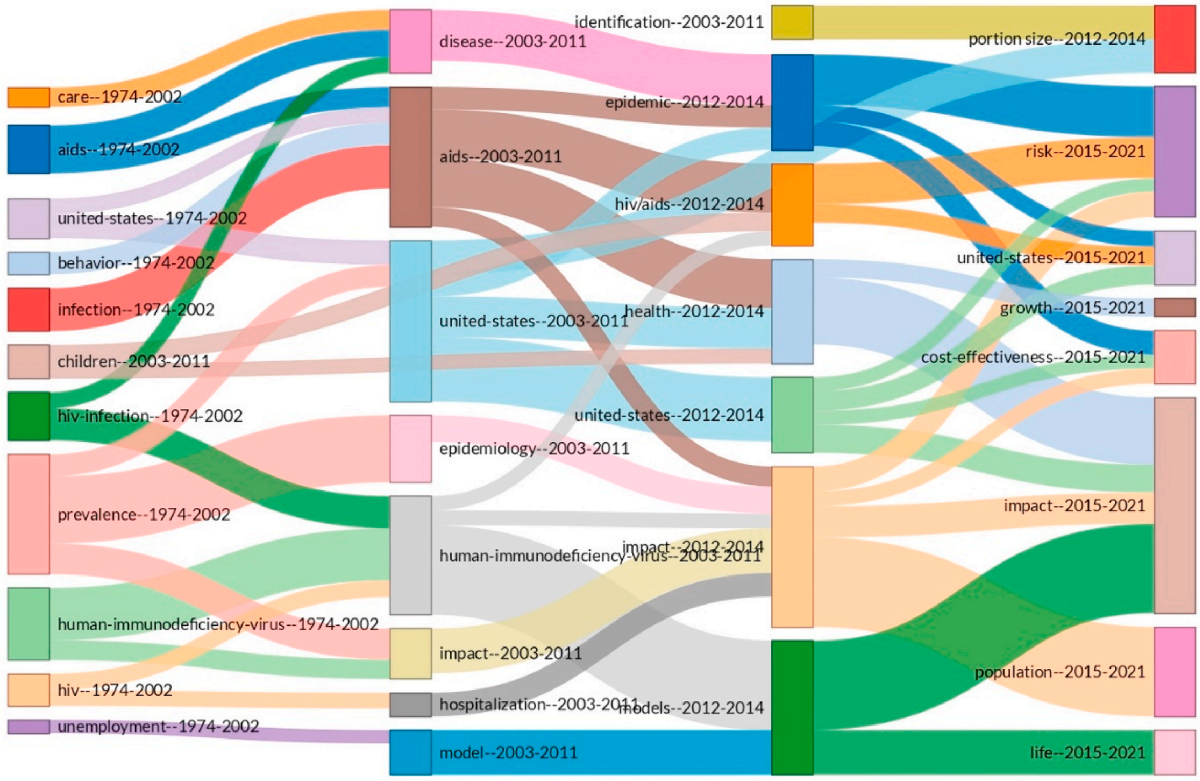

Fig. 10. Thematic evolution over the periods.

scientific contributions are concentrated predominantly by a small number of institutions (i.e., the UK, Canada, and the Netherlands). Whereas institutional concentration in publications is relatively lower and the publications are contributed by many universities or research institutions (i.e., the US, China).

4.1.3. What are the top keywords and the related prominent research clusters?

Keyword analysis provides interesting findings like impact, health, united states, risk, epidemic, and mortality among the most used keywords in the research. Along with the dominance of the study based on the US in the country analysis in the earlier section, we find a remarkable dominance even in the analysis of the keyword. The appearance of the keywords 'united-states' provides further evidence of the geographical intensity of the research. Although the other most used keywords do not explicitly represent the economic traits of publications. Moreover, we identify five main research clusters based on the association of keywords used in the publications. Out of the five research clusters, only the two major clusters capture the interest in different economic research attributes to represent issues like economic growth, income, demand, or consumption. Furthermore, particular importance is given to 'policy', 'cost-effectiveness', 'strategies,' or 'management.' The findings imply that the publications historically focus on the general issues related to economics, to some extent.

4.1.4. How are the progression of research in the field of economics and the relative changes during different infectious disease outbreaks?

By subdividing the publication into different timeframe, based on the time of various outbreaks related to COVID-19, we find that the most dominating disease investigated by the researchers is HIV or AIDS. Such intensity is not observed for the diseases caused by the coronavirus. Notably, after the sample's time-specific splitting, the collective dominance of the concerns directly connected to economics loses the required significance, thus, unidentifiable at different periods independently. The only economic aspect that is considered substantial in the existing studies is the 'cost-effectiveness.'

4.2. Future research agenda

Our multi-facet review of the literature identifies some gaps that future research can consider filling in. These issues have particular importance in dealing with the current and future epidemic or pandemic. The reoccurrences of different coronavirus diseases (i.e., COVID-19, SARS, MERS, etc.) entail the importance of precautions and early response capabilities. The scholarly community expects to contribute more research. While scientists usually dominate research on disease or outbreak, a significant amount of academic contributions are expected from social scientists, especially those doing research in economics or related areas. An appropriate economic response model would help the government and policymakers maintain resilience during such a crisis besides maintaining public health safety.

Accordingly, future research can focus on the cost and effectiveness of different containment measures that have been imposed by different countries across the globe;. finding the economical and most cost-effective control measures would help policymakers implement such action quickly and efficiently in the future. Besides, the timing and preparedness of policy interventions are pivotal in dealing with the adverse effects of the pandemic. Since we already have different examples from different countries, appropriate analysis and policy advocacy could be another aspect that future researchers may want to endeavor. Moreover, researchers can attempt to analyze the efficacy of and shock to different new economic models followed by the businesses in recent times; such as, comparing the impact on circular, sharing, or platform economies. In-depth analysis and contrast will help the business managers and the policymakers develop appropriate business strategies and monitoring policies. On top of that, the problem and prospects of the digital economy can be a remarkable area to investigate given the rapid disruptions incited further by the COVID-19 pandemic.

Analysis of other emerging issues related to globalization, sustainability, or environmental economics aspects with the lens of the COVID-19 crisis can be interesting research issues for the future too.

We observe a multi-phase dynamic in the COVID-19 pandemic. Existing studies do not highlight these issues; instead, they focus on a specific crisis. Perhaps, the economics researchers need to look into the crisis from different perspectives – analysis of economics and financial turmoil created by earlier pandemic could provide better insights to deal with the present and future disruptions. Finally, the COVID-19 pandemic has a regional variance and varies from sector to sector, one country to another country, and one region to another region. Also, the WHO global research roadmap highlights the need to adjust research following the local needs and realities and implies a need for collaborative research with comprehensive data from diverse regions. However, we fail to find diversification of scientific activities as evidenced by the high concentration of publications by the developed countries and their nature of collaborations. Hence, future studies call for combined, collaborative, and substantial timely research efforts with local experiences to find the best practical solutions to draw an end to this health and economic pandemic crisis.

CRediT authorship contribution statement

Masnun Mahi: Conceptualization, Data curation, Formal analysis, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing. **Mohammad Ashraful Mobin:** Conceptualization, Methodology, Supervision, Validation, Writing – review & editing. **Marzia Habib:** Writing – original draft, Writing – review & editing. **Shabiha Akter:** Formal analysis, Software, Visualization, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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