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A bibliometric analysis of coronavirus disease (COVID-19) mortality rate

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) has had a profound global effect on mortality rates. There were many studies about mortality and COVID-19, but there is no study about bibliometric analysis of these studies. This study provides a general overview of studies on the mortality rate of COVID-19.

Methods: Publications on mortality rate during the COVID-19 pandemic from December 1, 2019, to November 17, 2021, were extracted from the Pubmed database. Bibliometrics indicator analysis was performed using Bibliometric/Biblioshiny, We used the following keywords: "covid-19 mortality[Title]"; "SARS-CoV-2 mortality[Title]"; "2019-nCoV mortality[Title]"; "SARS-CoV-2"[MeSH Terms]"; "SARS-CoV-2"; "2019 ncov"; "mortality"[Title]".

Results: From December 1, 2019, to November 17, 2021, 2,848 documents were retrieved, with 2,202 (or 77.3 %) being journal articles. Most publications were produced by the Plos One journal (93 3,3 %). Wang Y, a Chinese author, has authored the most articles on this topic (64, 8.91 %). The strongest cooperating countries' network consisted of the United States, Italy, France, China, and Spain. Ten keyword clusters identifying mortality hotspots were discovered.

Conclusion: Bibliometrix analysis of the mortality rate in COVID-19 is helpful for mapping studies related to the mortality rate of COVID-19. This article provides an overview of further research related to mortality in COVID-19.

Keywords: bibliometric analysis, COVID-19, mortality rate, SARS-COV-2.
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INTRODUCTION

In December 2019, a new strain of coronavirus (COVID-19) was first detected in Wuhan, China. The virus causes fever, cough, fatigue, loss of taste and smell, dyspnea, myalgia, vomiting, diarrhea, and progressive diseases.[1] The investigations revealed that a novel coronavirus (2019-nCoV) was the causative agent of the disease, which was subsequently named COVID-19.[2] Since then, this disease has spread to 216 countries and territories worldwide, with daily high cases in North American, European, and North African countries.[3] This highly contagious pathogen has affected almost every aspect of our daily lives, such as education, traveling, business, transportation, sports, and health care.[4]

Compared to similar infections, SARS-CoV and MERS-CoV, the rate of spread is much faster, with a mortality rate of 2.08%.[5] Even in comorbid patients, the mortality reaches 42%.[6] As of November 2021, it had infected more than 258 million people with more than 5 million deaths.[7] Authorities must undertake effective public health measures connected to COVID-19 surveillance, diagnostics, vaccinations, treatments, and research to reduce the impact of the virus.[8]

Given the novelty and lack of knowledge about the disease, research can play a crucial role in the fight against the COVID-19 pandemic. Scientists have been rapidly mobilized to manage and slow down the growth of the pandemic. The scientific literature in this domain area has exponentially increased.[9,10]

It is very important to have a comprehensive overview of the current state of the literature on COVID-19 mortality for several reasons, such as 1) to organize and coordinate the literature; 2) to explore the research topics addressed; 3) to understand the evolution of the literature; 4) to recognize the leading researchers, institutes, and countries in this area.

This work seeks to undertake an exhaustive bibliometric analysis to offer a complete document overview of the available COVID-19 mortality literature to cover the gaps described above.

MATERIALS AND METHODS

Study Data Collection and Search Strategy

Pubmed (Pubmed.gov) Core Collections were used to find publications for analysis. For the analysis, we used the following keywords: covid-19 mortality[Title], SARS-CoV-2 mortality[Title], 2019-nCoV mortality[Title], (("SARS-CoV-2"[Mesh Terms], SARS-CoV-2, 2019 ncov. We used the update corresponding to the timestamp of December 1, 2019, to November 19, 2021. All languages and documents were included for data searching. Then, from the search results, besides being stored as a PubMed document for bibliometric analysis, it was also saved in an excel document to ensure that the document's title contained relevant keywords and could be used for manual searches when needed.

Data Analysis

The bibliometric analysis and all other processes were carried out with Biblioshiny, a web-interface application for Bibliometrix analysis (version 2.0, https://www.bibliometrix.org/Biblioshiny.html) accessed with R-Studio.

RESULT

Most publication type

In total, 2.848 publications were retrieved. Nine hundred ninety-seven articles published in 2020 and 1851 articles published in 2020 were analyzed, which included 2202 (77.3%) journal articles, 293 (10.3%) comments, 184 (14.9%) editorials, 157 (5.5%) letters, and any other forms of publication, including comparative study and clinical study. The language of all the publications was English. No document citation was found, so there were no documents citing each other during the two years. In full, the details can be seen in table 1.

Most productive institutions

In all, 29,552 documents were published, with 7,353 institutions participating. The volume of papers (2,848) demonstrated that several universities coordinated to conduct research. Most productive institutions were from mainland China, the United States of America, and European countries (Table 2). Among the top 10 institutions, two were in China, two were in the United Kingdom, half were in the United States, and one was in France. USA institutions were the most active, but Huazhong University of Science and Technology published the most articles (Table 2)

Most productive journal

Most of the top 10 journals were infections journals (Table 3). They were relevant to the topic of this study.

Keyword

In addition, the keyword analysis highlighted the dominance of mortality topics in COVID-19 with keywords such as "human," "SARS-COV-2", "female", "aged", and "male". The 18.012 keywords provide critical information on the dynamics of the issues and the larger scope of this study (Table 4 and figure 1).

Recent keywords and keyword change trends

When comparing the first trimester of 2020 to the last trimester of 2021, there appears to be a little variation in keywords in the top 20 over two years. Keywords that have recently gotten into the top 20: "covid-19/mortality", "SARS-COV-2/ isolation & purification", and "prognosis" (table 5)

Most productive author

There were 2.848 publications with a total of 20.886 authors, meaning that each publication was written by an average of 7.3 authors, and based on the spelling of their names, they were Chinese. The ten most productive authors produced an average of at least 20 documents in the 2020-2021 period (table 5).

Table 1. Top 10 Documents publishing COVID-19 (2019-2021).

Document type	Number of publications	%
case reports	20	0.7
clinical trial	27	1
comment	293	10.3
comparative study	41	1.4
editorial	29	1.0
evaluation study	8	0.3
journal article	2,202	77.3
letter	157	5.5
others	71	2.5
case reports	20	0.7

Table 2. Top 10 institutions publishing COVID-19 (2019-2021).

Institution	Number of publications	%
Huazhong University Of Science And Technology	746	26.19
Icahn School Of Medicine At Mount Sinai	275	9.66
Harvard Medical School	186	6.53
Imperial College London	185	6.50
University Of Oxford	168	5.90
University Of Health Sciences	160	5.62
Renmin Hospital Of Wuhan University	145	5.09
Albert Einstein College Of Medicine	143	5.02
Université de Paris	134	4.71
Mayo Clinic	126	4.42

Table 3. Top 10 journals publishing COVID-19 (2019-2021).

Journal	Number of documents	%
Plos One	93	3.3
International Journal Of of Infectious Diseases: Ijid: Official Publication Of of The International Society For Infectious Diseases	53	1.9
Scientific Reports	48	1.7
Journal Of Medical Virology	42	1.5
Bmj Open	38	1.3
International Journal Of of Environmental Research and Public Health	38	1.3
The Journal Of of Infection	35	1.2
Medrxiv: The Preprint Server For for Health Sciences	33	1.2
Clinical Infectious Diseases: An Official Publication Of of The Infectious Diseases Society Of of America	29	1.0
Jama Network Open	28	1.0

Country collaboration and country productivity

A total of 107 nations contributed to the publication, with the bulk coming from Europe, the United States, and China. It was pertinent for publications, authors, and connections in which the nations indicated were dominating yet somewhat different when examined in terms of the country's production (figure 2). If most of the author's output originated in China, the nations were ruled by Americans and Europeans. China remained one of the world's most productive nations. It also implies that partnerships between institutions and universities and collaborations between authors facilitate cross-national cooperation. The high degree of cooperation seen in Figure 2 demonstrates both the quality and quantity of collaboration. Europe's partnerships with the United States, Australia, and China were robust.

DISCUSSION

Scientific publications are essential for obtaining information, especially in the medical field. In the future, the latest scientific publications in the medical field are a means to develop the best treatment for certain diseases. Analysis of research developments will help all parties involved, especially researchers, gain an objective perspective on the quality and quantity of research. In particular, bibliometric analysis allows researchers to analyze research in specific fields. Bibliometrics analysis is related to authors, journals, affiliations, widely used keywords, types of publications, and collaborating countries. One of them is the theme and title of this study, namely the mortality rate in COVID-19 patients. Bibliometric analysis has been carried out and presented in several tables and figures.

Compared to similar infections, which are strongly related to mortality rates, COVID-19 is an infectious disease with a high mortality rate. A study of mortality can also make anyone aware of it. There have been thousands of articles about the fatality rate in less than two years since the outbreak began. From 2020 to 2021, the number of publications on the mortality rate rapidly increased. The first article on COVID-19 focused on mortality rates, especially publications from the PubMed database. In general, the relationship between mortality rate and COVID-19 has been described in this study.

There were 2.848 documents or publications related to the mortality rate in COVID-19 involving 20.886 authors, 991 journals, 107 countries, and 7.353 institutions or universities. So far, no citations have been found from the above publications. It may be because the research span was only two years and Bibliometric analysis was generally unable to detect citations of articles less than three years of publication.[11] All documents found were in English and involved many countries, especially the United States, Spain, Italy, France, and China.

Institutions or hospitals have a strong working relationship. There were 7.353 institutes or hospitals that produced 29.552 documents. It was identified from 2.848 universities or institutions, including hospitals, collaborating to produce each document. On average, ten institutions' collaboration results were obtained from one publication. It was reasonable that there were numerous documents, including hospital data gathering publications and journals involving numerous scientific fields. Most institutions were from China, Europe, and the United States. It shows that countries collaborated through institutions or colleges from the countries mentioned.

Table 4. Top 10 keywords from articles publishing COVID-19 (2019—2021).

Keyword	No Number of keywords	%
Humans	2284	13
Sars-cov-2	1742	10
Covid-19	1252	7
male	1133	6
female	1111	6
aged	981	5
pandemics	936	5
Middle ages	909	5
retrospective studies	621	3
adult	570	3

Table 5. Comparing the top 20 keywords between First Trimester 2020 Vs. End Trimester 2021.

The first trimester of 2020				The End Trimester of 2021			
no	Keyword	no	Keyword	no	Keyword	no	Keyword
1	humans	11	pandemics	1	humans	11	aged 80 and over
2	sars-cov-2	12	hospital mortality	2	sars-cov-2	12	hospital mortality
3	covid-19	13	aged 80 and over	3	male	13	pandemics
4	male	14	severity of illness index	4	female	14	hospitalization
5	aged	15	cohort studies	5	aged	15	severity of illness index
6	female	16	hospitalization	6	middle aged	16	comorbidity
7	middle aged	17	comorbidity	7	retrospective studies	17	prognosis
8	retrospective studies	18	adolescent	8	covid-19	18	covid-19/mortality
9	risk factors	19	child	9	adult	19	sars-cov-2/isolation & purification
10	adult	20	young adult	10	risk factors	20	cohort studies

Data from the top ten journals published in these nations confirmed that statement.

The increased incidence was directly correlated with the high productivity of article writing from American and European countries. Positive confirmed cases were dominated by countries in America with over 96 million positive confirmed cases, of which 47 million cases were from the United States, followed by countries in Europe with over 84 million positive confirmed cases.[12] A meta-analysis involving 261 countries described that countries in America and Europe were at the top of the list in daily cases.[3] A meta-analysis from 58 studies with 122,191 hospitalized patients stated that the average mortality prevalence was 18.88%, the highest in European countries (26.85%) and the lowest in Asian countries (14.83%).[13]

Between the first trimester of 2020 (the start of the pandemic) and the final trimester of 2021, 2 new keywords emerged. The first keyword was "prognosis". A bad prognosis is found in patients with both Acute Pancreatitis and COVID-19. Bad prognosis increases even more in the presence of COVID-19-associated pneumonia.[13] A meta-analysis from 28 studies with 13.387 patients mentioned that procalcitonin had more accuracy for the prognosis of mortality compared to critical conditions.[14] Worsened prognosis occurs in cancer survivors.[15] There were no significant findings regarding angiotensin II and ACE2 levels on the presentation that could be used in the prognosis and mortality of COVID-19 patients and the development of future treatment methods.[16]

The second was the keyword "SARS-CoV-2/isolation & purification" where the relevant keyword was "social distancing", which was a response to the COVID-19 pandemic.[17] School closure in the USA was not associated with increased mortality.[18] Studies in 37 countries showed that early application of mass gathering bans and school closures in outbreak epicenters was associated with an important reduction in COVID-19 cumulative mortality during the first pandemic wave. These findings may support policy decisions.[19] Other studies in African-European countries showed that social distancing decreased mortality and fatality rates.[20]

Table 6. **Top 10 Authors publishing COVID-19 articles (2019—2021).**

Author	Number of Documents	Articles fractionalized
Wang Y	64	8.91
Li Y	37	4.80
Li H	28	2.61
Liu Y	28	3.53
Li J	25	2.26
Li X	24	2.86
Yang H	23	3.45
Zhang L	23	2.52
Wang X	20	2.34
Zhang J	20	2.86

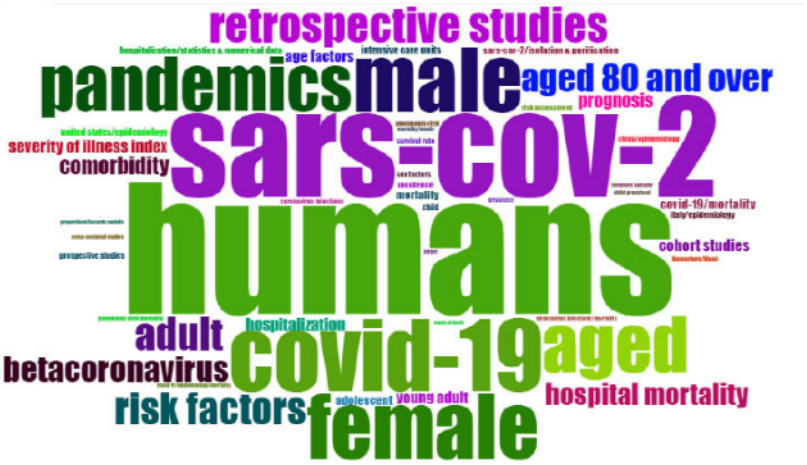

Figure 1. The size of the letters describes the level of frequent use of keywords. The image was taken from Biblioshiny, a web-interface application for analysis software Bibliometrix (version 2.0, https://www.bibliometrix.org/Biblioshiny.html)

Besides the information provided above, the most used general keywords were human, SARS-CoV-2, and COVID-19. The top 10 keyword popularity was dominated by keywords related to gender and age, such as male, female, aged, adult, and middle age. Nineteen article titles used the word age, 87 titles used the word old, and 64 titles used the word adult in the search results. As a result, almost 170 titles with a mortality rate theme related to age. Meanwhile, the author mentions the word old 981 times as a keyword. Most of them were related to comorbidity, gender, and drug usage. Several studies found a correlation between getting older and having a higher mortality rate.[21–23]

Other top ten list keywords concerning age were mostly related to genders, such as male and female. The word male occurred in 22 titles, whereas the word female appeared in 6 titles; the derivative word, gender, occurred in 19 titles; the word sex occurred in 38 titles; and then, the word women appeared in 22 titles. As a result, the document titles contained over 100 related keywords linked to gender. Studies including 100.000 and 66.000 samples in Europe and America indicated that men had a greater mortality rate than women.[24,25]

Keyword comorbid was linked to many chronic diseases. For example, hypertension was linked to 19 titles, cardiovascular disease was linked to 72 titles, cancer was linked to 101 titles, diabetes was linked to 81 titles, and asthma was linked to 10 titles. Comorbidity generally increases mortality. A meta-

analysis involving 89.238 patients, of which 11.341 had comorbidities drawn from 39 publications, stated that comorbid hypertension, chronic heart disease, diabetes, cancer, and COPD increased mortality.[6] Another meta-analysis from 145 studies inferred that the highest mortality was due to comorbid diabetes, hypertension, and obesity.[26] A meta-analysis involving 344.431 patients from 34 publications stated that CVD, CKD, CHD, and malignancy were associated with an increased risk of progression and mortality in COVID-19 patients.[27]

A study involving 800 patients in the U.K. mentioned that cancer comorbidities did not increase mortality.[28] That results were the same as those of a study in India involving 186 patients.[29] Another study in Brazil with 198 patients stated an increase in mortality in COVID-19 patients with cancer comorbidities, especially the elderly and smokers.[30] The results were similar to those of a study in China involving 168 patients.[31] A meta-analysis involving 2.922 cancer patients from 13 studies concluded a 30% increase in mortality in cancer patients.[32]

A meta-analysis of 33 studies involving 1,000 participants found that diabetes with COVID-19 doubled mortality and severity compared to non-diabetics.[33] A meta-analysis involving 744 patients from 4 studies stated that asthma as comorbidity might not increase the mortality of COVID-19.[34] A meta-analysis with 99.018 patients from 24 studies mentioned that hypertension was independently associated with a significantly increased risk of critical COVID-19 and in-hospital mortality of COVID-19.[35] A meta-analysis from 18 journals involving 74.142 patients stated that dyslipidemia represented major comorbidity in about 18% of COVID-19 patients. However, it was associated with a 60% increase in short-term mortality risk.[36]

A meta-analysis of 10.122 patients from 22 publications described lower total, HDL, and LDL-cholesterol, but not triglyceride concentrations, were significantly associated with COVID-19 severity and mortality.[37] A meta-analysis from 19 publications involving 2.937 patients inferred that the echocardiographic parameters of Right Ventricular Disease were associated with increased mortality risk in COVID-19 patients.[38] A meta-analysis from 28 publications involving 12.995 patients mentioned that dyslipidemia was associated with increased severity and mortality of COVID-19.[39] A meta-analysis from 29 studies involving 3.562 patients mentioned that the cardiac markers (CK-MB, PCT, BNP, NT-proBNP, troponin, and D-dimer levels) as key laboratory parameters for diagnosis and prognosis and with which to predict the severity and mortality of COVID-19. D-dimer is the best predictor of severity and mortality in COVID-19 patients.[40]

The drugs used were also related to comorbid keywords, such as cardiovascular and diabetes. The results of a meta-analysis of the role of aspirin in mortality involving

Figure 2. The network visualization of collaboration map among countries. The map was generated through "Biblioshiny", a shiny app providing a web interface for Bibliometrix software (version 2.0, https://www.bibliometrix.org/Biblioshiny.html). Brown lines indicate collaborations between countries.

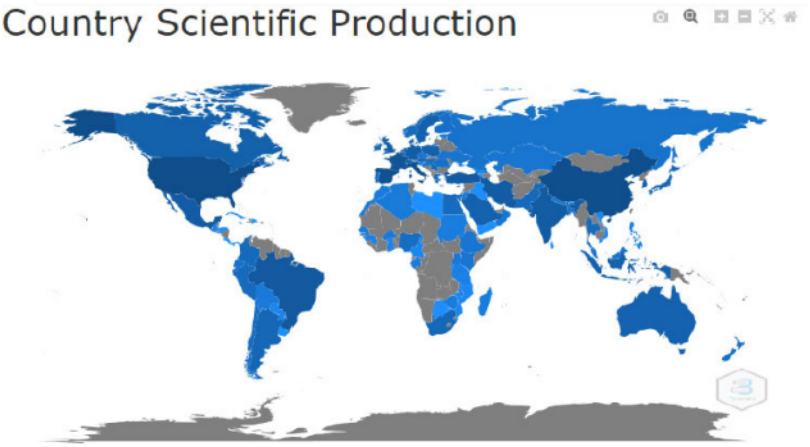

Figure 3. Scientific production by country. The map was generated through "Biblioshiny", a shiny app providing a web interface for Bibliometrix software (version 2.0, https://www.bibliometrix.org/Biblioshiny.html). Different shades of blue indicate different productivity rates: dark blue = high productivity; grey = no articles.

56.696 COVID-19 patients from 10 journals inferred that aspirin reduced the mortality of COVID-19 patients.[41] A meta-analysis of 26 journals involving 8.389 people who received ACEI or ARB drugs stated that they were not associated with mortality but with worsening the patient's condition.[42,43] The results of a meta-analysis of the use of methylprednisolone taken from 5 publications involving 652 patients showed that methylprednisolone did not reduce mortality.[44]

If it is associated with the keywords found, the meta-analysis results of the mortality of COVID -19 patients involving 423.117 patients from 42 articles showed that the high mortality was successively due to age, male gender, and smoking habits. Then, it is also caused by comorbid CPOD, cardiovascular, diabetes, hypertension, obesity, cancer, and kidney disease.[45,46]

Chinese authors dominate the top ten most productive writers, producing more than 20 articles a year over the last two years, and this was relevant to Huazhong University, the most productive institution. The data acquired included 31 documents whose studies had Wuhan as their focus, with Huazhong University ranked first in affiliations with 746 publications. Besides Huazhong University, Renmin Hospital of Wuhan University was among the top ten most productive affiliates. Huazhong University and Renmin Hospital are in Wuhan, China, where the first COVID-19 case was detected.

Limitations of the study

This study is the first bibliometric analysis that evaluates and visualizes the trend of published mortality rate documents in COVID-19 from PubMed databases. Nevertheless, the study also has some specific limitations. We restricted our search to PubMed databases and did not compare our findings with other scientific databases such as Web of Science (WoS), Embase, Cochrane Library, Scopus, and Google Scholar. In addition, the Bibliometrix/biblioshiny application has a limited visualization and the risk of data being read more than once. Bibliometric analysis generally cannot detect citations of articles less than three years of publication.[46]

CONCLUSION

Bibliometrics analysis of the mortality rate in COVID-19 patients is helpful for mapping studies related to the mortality rate of COVID-19 patients. This study provides an overview for further research related to mortality in COVID-19 cases, for example, by searching for the keywords mortality rate associated with age, gender, and comorbidities such as cancer, cardiovascular, and diabetes.

ETHICAL CLEARANCE

Ethical clearance does not require in this study.

CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

AUTHOR CONTRIBUTION

HK has a responsibility to manage the data and analyze the sample. AY and DAP arranged the body of the manuscript and collected the data.

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