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Original Article

Global network analysis on COVID-19 related acute respiratory distress syndrome

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ABSTRACT

Objectives: This study aims to examine the studies on COVID-related ARDS globally.

Materials and methods: The Web of Science (WoS) database was scanned to search for publications until December 31, 2020. Results were analyzed to present various bibliometric indicators, the maps were visualized using the VOSviewer program (VOSviewer). The Hirsch (h-index) index and impact factor (IF) of the publishing journals were used as indicators of the impact of the publications. The publications containing the keywords "COVID-19" or "SARS-CoV-2" and "acute respiratory distress syndrome" or "ARDS" were examined.

Results: A total 113 articles were evaluated. The average number of citations was found to be 26.97. The majority of the publications were from the USA (29.20%). Most cited articles were published in the European Respiratory Journal and Frontiers in Medicine journals, but most of the publications were from Critical Care and Cureus journals.

Conclusion: With the spread of the pandemic, bibliometric analysis should be used more widely in order to evaluate the quality of the increasing academic paper and to guide the missing study issues.

Keywords: Acute respiratory distress syndrome, COVID-19, global network analysis.

The Coronavirus Disease 2019 (COVID-19) was first detected in Wuhan, China in December 2019. The World Health Organization (WHO) declared the disease a pandemic after that.[1] COVID-19 is a highly contagious mortal disease that can particularly lead to acute respiratory distress syndrome (ARDS). COVID-19-associated ARDS (CARDS) remains a global concern, owing to the fact that ARDS induced by others varies in terms of both onset time and progression, the ongoing uncertainty in treatment, and one of the possible causes of death. Understanding the features of CARDS is crucial for early diagnosis and definitive treatment. It has become a global goal to define the characteristics of CARDS, determine which factors cause ARDS, and reduce mortality rates.[2-4]

There have been 104 bibliometric analyzes on COVID-19 published worldwide, but there have been no publications on CARDS. In our study, we aimed to examine previous research on CARDS and to guide future investigations.

MATERIALS AND METHODS

Bibliometric analysis,[5] which includes the application of mathematical and statistical methods to scientific publications, is the cornerstone of modern literature.[6] In our study, the Web of Science (WoS) database (https://www.webofknowledge.com) was scanned for publications until December 31, 2020. The study was conducted in accordance with the

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Table 1. The countries where the article was published

Country	n	%
United States of America	33	29.2
Italy	226	19.5
France	144	12.4
Germany	118	9.7
China	11	9.7
Canada	6	5.3
Iran	5	4.4
Brazil	4	3.5
England	4	3.5
Spain	4	3.5
India	3	2.6
Japan	3	2.6
Netherlands	3	2.6
Türkiye	3	2.6
Austria	2	1.8
Russia	2	1.8
South Korea	2	1.8
Switzerland	2	1.8
Other countries*		

* Other: Argentina, Australia, Belgium, Chile, Colombia, Czechia, Egypt, Indonesia, Ireland, Mexico, Nigeria, Poland, Qatar, Romania, Saudi Arabia, Singapore, South Africa, Sweden, Thailand, Tunisia.

principles of the Declaration of Helsinki. The WoS database includes articles indexed in (SCI-E), Social Science Citation Index (SSC-I), Arts & Humanities Citation Index (A&HCI), Conference Proceedings Citation Index - Science (CPCI-S), Conference Proceedings Citation Index- Social Science & Humanities (CPCI-SSH), Book Citation Index-Science (BKCI-S), Book Citation Index-Social Sciences & Humanities (BKCI-SSH), Emerging Sources Citation Index (ESCI) journals. While the data obtained in our study were analyzed to present various bibliometric indicators, the maps were visualized using the VOSviewer program (VOSviewer developed by the University of Leiden (Leiden, Netherlands). The Hirsch (h-index) index and impact factor (IF) of the publishing journal were used as indicators of the impact of the publications. The publications containing the keywords "COVID-19" or "SARS-CoV-2" and "acute respiratory distress syndrome" or "ARDS" were examined.

As a result of this search, a total of 263 published studies were found. By filtering the research articles, a total of 113 studies were obtained from these results. The study excluded publications such as reviews, case reports, and letters to the editor. Citation links were examined between the dates of publication, the publication language, the number of citations, the field of research, the name of the journal, the country of publication, and the countries cited.

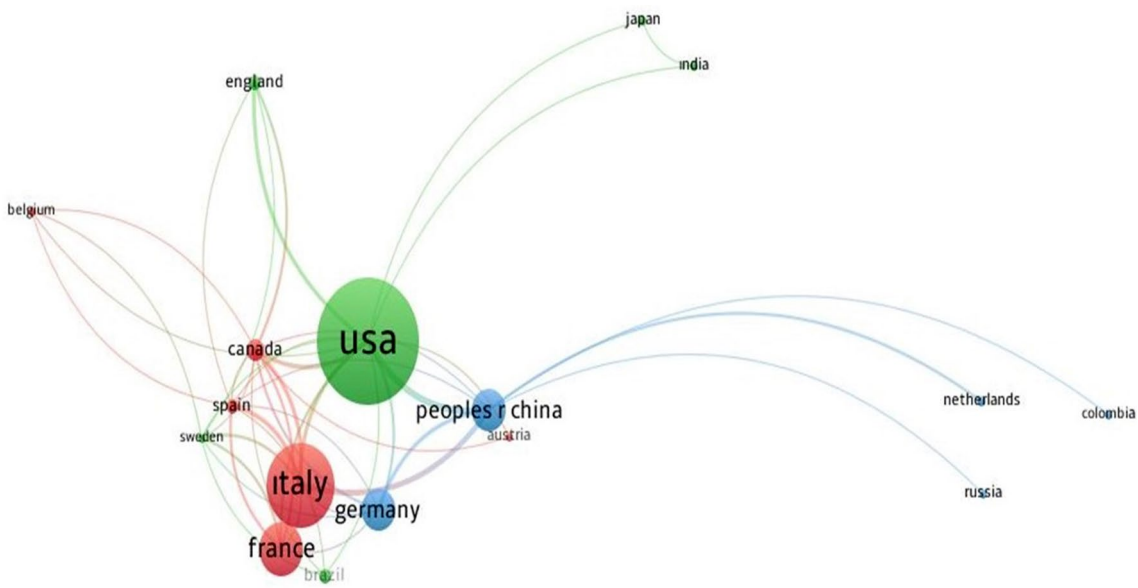

Figure 1. Network visualization map prepared according to the document numbers of publications on CARDS. Lines connecting countries are indicative of citations. Countries represented by larger circle size or font size have relatively more articles.

RESULTS

In our study, 113 research articles were evaluated. The average number of citations for these 113 articles was 26.97. Although the search was conducted between 1970 and 2021, all the articles were written in 2020. When the months in which the articles were published were examined, it was found that the highest number was in August, and there has been a rapid increase in numbers since March.

The publications were mostly written in English (n=110, 97.3%), then in German (n=2, 1.8%), and lastly in French (n=1, 0.885%). An investigation of the countries where the articles are published; United States (USA) (n=33, 29.2%), Italy (n=22, 19.5%), France (n=14, 12.4%), Germany (n=11, 9.7%), China (n=11,% 9.7), Canada (n=6, 5.3%), Iran (n=5, 4.4%), Brazil (n=4, 3.5%), England (n=4, 3.5%), Spain (n=4, 3.5%), India (n=3, 2.6%), Japan (n=3, 2.6%), the Netherlands (n=3, 2.6%), Türkiye (n=3, 2.6%) and had been broadcast from five continents, along with other countries (Table 1, Figure 1).

As a result of the analysis of the journals in which the articles were published, it was determined that the majority of the articles on CARDS were published in Critical Care and Cureus journals.

Characteristics of publication attribution The h-index of these articles, which were cited a total of 3,048 times, was found to be 16. Figure 2 evaluates citation features.

While 61 (54%) of the articles were cited, 53 (46%) articles were never cited. The number of citations ranged from 0 to 91. Two articles were cited 91 times. These articles were published in the European Respiratory Journal and Frontiers in Medicine journals. One article dealt with pathogenesis, while the other claimed that Spironolactone could be used to treat COVID-19. Both articles were published in the US and were written in English. An article about steroid use published in Canada was the third most cited article (with 88 citations). Table 2 shows the ranking of the top 10 most cited articles. According to the content analysis of the articles, the most common topics were treatment (40.7%), clinical characteristics (29.2%), laboratory research (7.1%), radiology research (6.2%), immunity (3.6%), prone position (3.6%), pathogenesis (2.7%), rehabilitation (1.8%), psychological effect (0.9%), and risk factors (0.9%).

DISCUSSION

Because of the high risk of death, most patients with COVID-19 pneumonia, especially the elderly and those with comorbidities, were followed up in intensive care units, and the majority of deaths are thought to be related to ARDS.[2] Acute respiratory distress syndrome was previously classified as mild, moderate, or severe based on the Berlin 2011 criteria, and the diagnostic criteria were redefined. However, according to existing reports, it attracts the attention of the researchers since COVID-19-associated ARDS differs from ARDS due to other etiologies and had some different

Table 2. The countries where the most cited articles were published and the evaluation of their content[6-15]

Citations	n	Country where the article was published	The content of the article
Torres Acosta and Singer[7]	91	USA	Pathogenesis
Cadegiani et al.[8]	91	USA	Treatment
Cheng et al.[9]	88	Canada	Treatment
Bektas et al.[10]	70	USA	Aging
Cismaru et al.[11]	62	Romania	Treatment
Candan et al.[12]	61	Türkiye	Preventing long-term con-sequences
Grieco et al.[13]	56	Italy	Physiology
Middleton et al.[14]	55	USA	Immunology
Notz et al.[15]	54	Germany	Immunology
Fan et al.[4]	54	USA	Treatment

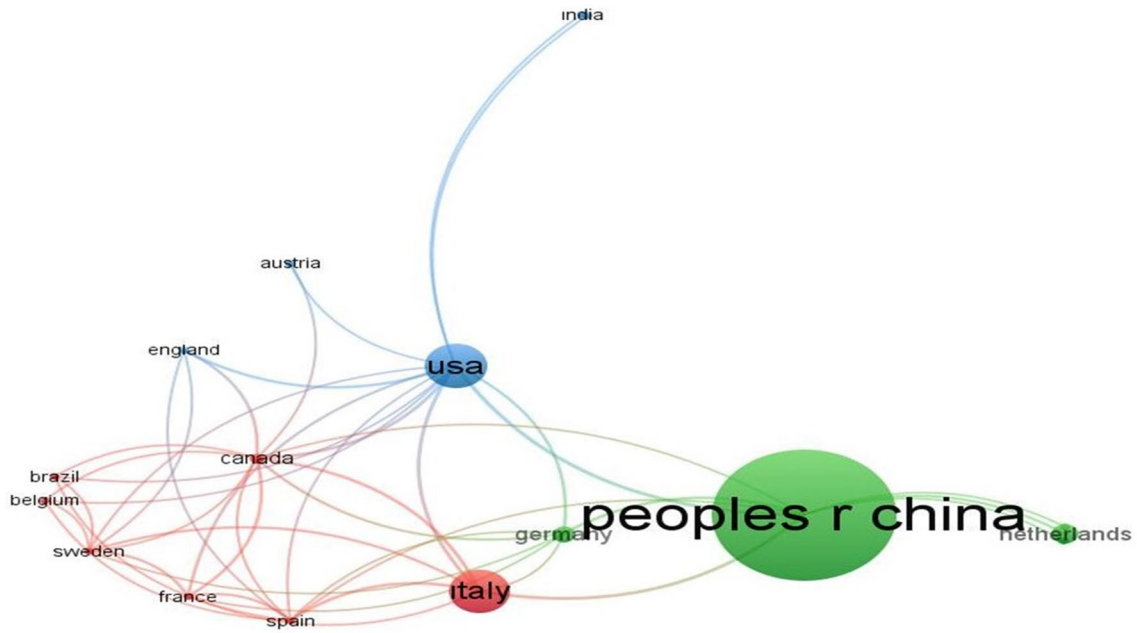

Figure 2. Network visualization map of citations among publications on CARDS. Lines connecting countries are indicative of citations. Countries represented by larger circle size or font size show relatively more citations.

clinical courses defined previously according to the Berlin criteria.[2,16]

COVID-19, declared a pandemic by WHO in March 2020, had been reported as of January 15, 2021, with 91,816,091 confirmed cases and 1,986,871 COVID-19 related deaths.[17] Given that ARDS is the leading cause of death, it is expected that research into this topic will accelerate. Based on a screening of the WoS index, one of the world's most prestigious academic indexes, we determined that the number of articles on this topic increased after March 2020. According to WHO data, the pandemic spread rapidly to other countries following case reports from the Hubei province of China, with the number of cases in the USA far exceeding the location where it originally appeared. According to WHO data, there are 40,548,449 confirmed cases in the USA, 40,548,449 in Europe, 12,399,976 in South-East Asia, 5,280,571 in the Eastern Mediterranean, and fewer confirmed cases in other continents.[17] In the detailed review of the publications; although the citations were from China, which is the first COVID-19 cases were reported, it was determined that the majority of the research articles were published in the USA. Italy was found to be the second most scientifically productive country for COVID-19-associated ARDS, with 2,336,279 confirmed cases and 80,848 deaths.

When looking at Europe in general (40,548,449), which is the second most frequent case after the USA, Italy (n=22, 19.5%), France (n=14, 12.4%), and Germany (n=11, 9.7%) were the countries where the most articles were published. As a result of our analysis, although there are only 9.7% of the original research articles in China on the subject under investigation, most of the citations are found to be at the beginning of the pandemic. Although there are many publications from China in the literature, only original research articles were examined in our study. In terms of citation rates, it was found that the most frequent citations after China were to the USA and Italy. The reason for this situation can be interpreted as the increased number of cases and publications.

When the PubMed database was examined; despite there being 91,161 published articles on COVID-19, only 2,847 (3.1%) of them were on COVID-19-associated ARDS. There were 33 clinical and 16 randomized controlled trials

published.[18] This situation can be interpreted as indicating the need for clinical and randomized controlled studies on CARDS, which is one of the main causes of COVID-19 related deaths.

LitCovid[19] is a free literature center that monitors up-to-date scientific information on COVID-19, and there are currently 89,927 articles available. It is the most comprehensive resource on the subject and contributes to the access of COVID-19 related articles in the PubMed database.

The articles on this site are valuable because they are updated daily, are organized geographically, and contain information on various research topics. Considering the distribution of the publications made on this website; there are 7,822 (8.7%) publications related to our topic; it was determined that the most COVID-19-associated ARDS publications were from China (8,097), the USA (5,149), Italy (2,749), England (1,952), and India (1,473). In the journals with the highest number of articles; BMJ (1,210), Int J Environ Res Public Health (781), PLoS One (718), J Med Virol (681), and Cureus (508). This was interpreted to mean that the national and numerical differences are determined by the indexes of the journals scanned in the WoS database. It has been emphasized that a COVID-19 patient who develops acute respiratory distress syndrome may eventually develop multi-organ failure if not managed individually.[20] The primary treatment for non-COVID-19-associated ARDS; together with the treatment of the underlying cause, ventilation with low tidal volume, prone position, and high positive end-expiratory pressure (PEEP) applications.[21] Extracorporeal membrane oxygenation (ECMO) is also one of the methods used in the treatment. In addition, supportive care plays an important role in the management of ARDS in intensive care. The main components of supportive care include proper use of sedatives, careful hemodynamic management, nutritional support, control of blood sugar, rapid assessment and treatment of nosocomial pneumonia, and prophylaxis against deep vein thrombosis (DVT) and gastrointestinal (GI) bleeding.[22] When the articles[23-47] in our study were examined; although the studies related to treatment are mostly experimental-observational when looking at the studies related to drug therapy; six studies on corticosteroids (3 studies of dexamethasone),[23-28] three studies of Anakinra,[29-31] four studies of tissue plasminogen activator[32-35] and tocilizumab[36-39] and two studies about nitric oxide.[40,41] There was only one publication on plasma therapy. In studies related to intensive care applications; four studies were on ECMO, three studies were on non-invasive mechanical ventilators.[39,46,47]

In the bibliometric analysis performed by Yu et al.,[48] a total of 3,626 publications on COVID-19 were examined, and the most common keywords were "pneumonia" and "epidemiology." It was found that the average number of citations of the 100 most cited articles was 96, with most studies focusing on descriptive and clinical features. The Lancet is the most cited British medical journal, focusing on disease management, clinical features, and pathogenesis.

In a bibliometric analysis conducted by Odone et al.,[49] 10,000 scientific articles on COVID-19 were examined between January 20 and May 7, 2020, and more than 60% of the articles reported that they were pieces of opinion that did not report the original data, that they were published in 1881 different journals, with the highest number of publications from the USA (25%), China (22.2%), and Italy (9%), 29.2%), France (n=14, 12.4%).

Another bibliometric analysis on COVID-19 found that most of the publications were also from the United States (32%).[50] The most cited articles in our study were published in the European Respiratory Journal and Frontiers in Medicine journals. One of these articles was about pathogenesis, and the other claimed that Spironolactone treatment can be used in COVID-19 patients. Both articles were published in English and in the USA. The majority of papers were published in Critical Care and Cureus journals.

The limitation of the study was that the analyses were conducted using the WoS database. However, as new articles are added to WoS every day as a result of the increasing number of publications due to the pandemic, the data may reflect the information until the day of the analysis.

In conclusion with the spread of the pandemic, bibliometric analysis should be used more widely to evaluate the quality of the growing number of academic papers and to guide the missing study issues. From the treatment of COVID-19-associated ARDS to its pathogenesis and, especially, its long-term consequences, it is an important issue that needs to be investigated.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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