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8
Current global research landscape on COVID-19 and cancer: Bibliometric and visualization analysis

Zyoud S *et al.* COVID-19 and cancer

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Abstract

BACKGROUND

Cancer is a severe public health issue that seriously jeopardizes the worldwide population's health. In individuals with coronavirus disease (COVID-19), cancer is considered an independent risk factor for severe illness and increased mortality.

AIM

To identify research hotspots and prospects, we used bibliometrics to examine the global production of COVID-19 Literature published in the field of oncology.

METHODS

Data of publication output are identified based on the Scopus between January 1, 2020, and June 21, 2022. This study used VOSviewer to analyse collaboration networks among countries and assess the terms most often used in the titles and abstracts of retrieved publications to determine research hotspots linked to cancer and COVID-19. The *Impact Index Per Article* for the top 10 high-cited papers collected from *Reference Citation Analysis* (RCA) is presented.

RESULTS

A total of 7,015 publications were retrieved from the database. The United States published the most articles (2025; 28.87%), followed by Italy (964; 13.74%), the United Kingdom (839; 11.96%), and China (538; 7.67%). *University of Texas MD Anderson Cancer Center* ($n = 205$, 2.92%) ranked first, followed by the *Memorial Sloan-Kettering Cancer Center* ($n = 176$, 2.51%). The *European Journal of Cancer* ($n = 106$, 1.51%) ranked first, followed by the *Frontiers in Oncology* ($n = 104$, 1.48%), *Cancers* ($n=102$, 1.45%), and *Pediatric Blood and Cancer* ($n=95$; 1.35%). The hot topics were stratified into “cancer care management during the COVID-19 pandemic”; and “COVID-19 vaccines in cancer patients”.

CONCLUSION

This is the first bibliometric analysis to look into the present state and upcoming hot themes connected to cancer with COVID-19 infection and vice versa using VOSviewer during the epidemic's early stages. The emergence of hot themes connected to cancer and COVID-19 infection may aid researchers in identifying new research areas in this field.

Key Words: Bibliometric; Scopus; COVID-19; Cancer; Coronavirus disease; VOSviewer; Reference Citation Analysis

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Core Tip: Many systematic reviews and meta-analyses found that the number of papers investigating the impact of COVID-19 on cancer in various countries increased during the epidemic. The existing literature on COVID-19, focusing on cancer research, has not been given by any bibliometric analysis. The hot topics were stratified into “cancer care management during the COVID-19 pandemic”; and “COVID-19 vaccines in cancer patients”. Cancer and COVID-19 infection have emerged as hot topics, which may help researchers uncover new research opportunities in this area.

INTRODUCTION

⁴The first confirmed case of coronavirus disease 2019 (COVID-19) was recorded in Wuhan, China, on December 31, 2019 [1]. Since that time, COVID-19 has been spreading rapidly and hitting throughout the world. Although some individuals diagnosed with COVID-19 remain without symptoms, patients who become symptomatic exhibit a wide range of severity, ranging from mild respiratory symptoms to critical lung disease,

sepsis, multiple organ failure, or even death ^[2, 3]. ¹ As of June 22, 2022, a total of 538,321,874 cases of COVID-19 have been confirmed worldwide, including 6,320,599 deaths ^[4]. According to the Sustainable Development Goals (SDGs) Report 2020, COVID-19 halts the progress of SDG 3, which seeks to guarantee well-being and healthy life for everyone. During the crisis, health services for cancer screening have been disrupted or ignored in many places ^[5].

Cancer patients represent a district group of the population with a weakened immune system due to anticancer treatments and disease activity ^[6, 7]. In pandemics like COVID-19, cancer patients may be deprived of receiving appropriate health care as many health institutes announced shortages of their resources, along with the inadequate information available in the literature to handle them properly ^[8]. Therefore, health care practitioners have to decide whether to initiate or defer anticancer treatments, considering the risks and benefits of such action. Notably, patients with active cancer are highly susceptible to COVID-19. They are suspected of having serious consequences, such as admission to the intensive care unit, a requirement of mechanical ventilation, or death ^[9]. These unfavorable outcomes could sometimes be related to types of cancer, particularly hematologic malignancies and lung cancer ^[9].

Some studies reported a death rate of 28% among COVID-19 patients with cancer, which was far higher than the general population's rate ^[10, 11]. It was also found that certain demographics and disease-related factors, including male gender, smoking, old age, having \geq two medical conditions, cancer status, and performance situation, were strongly associated with the mortality rate among COVID-19 cancer patients ^[12, 13]. However, receiving antitumor therapy within four weeks of diagnosis with ¹ the severe acute respiratory syndrome, coronavirus 2 (SARS-CoV-2) infection was not associated with death rate ^[10].

⁶ According to several systematic reviews and meta-analysis studies, the number of publications analyzing the impact of COVID-19 on cancer in various nations increased during the epidemic ^[14-18]. Although various bibliometric studies have been undertaken to evaluate COVID-19 research worldwide ^[19-23], limited studies have been identified

that have presented the current literature on COVID-19, focusing on cancer research. The bibliometric methodology was utilized to measure and categorize research output, allowing for mapping the subject area based on the most involved authors, institutions, nations, citations, journals, and hot topics [24-28]. Therefore, this study sought to comprehensively analyze the current status of publications on COVID-19 in the oncology field through visual and bibliometric analysis. This study intends to be a valuable resource and guide for oncologists, clinicians, virologists, and epidemiologists conducting research on the emerging human coronavirus in the field of cancer in order to generate novel ideas for effective control measures and to outline COVID-19 vaccine guidance for cancer patients as soon as possible.

MATERIALS AND METHODS

Data source

The present study, which includes the analysis, occurred in June 2022. The authors utilized the Scopus database to find relevant publications because (1) it is available to the author through the "Research4 Life" library, (2) it is the largest database available, and it has a more significant number of indexed journals than other databases (e.g., PubMed or Web of Science) and is completely inclusive of all journals in Medline^[29-31], and (3) it indexes journals in the disciplines of health, social sciences, life sciences, and physical sciences ^[32, 33]. In addition, Scopus has previously been used to analyze and visualize research publications on various health-related topics ^[34-38].

Search strategies

In order to obtain all publications pertaining to COVID-19 and cancer published between January 1, 2020, and June 21, 2022, we employ the 'Advanced search' feature of the Scopus online database. The retrieval and export of data should take place within one day to avoid the risk of bias induced by ongoing database changes (June 21, 2022). The following strategy was used to retrieve data for this study (Figure 1):

Step 1: The phrases associated with COVID-19 were entered into the Scopus engine to accomplish the study's objectives. They were drawn from previous bibliometric

research on COVID-19 [20, 21, 39-41]. All selected "terms" were included in the "Article Title/Abstract/Keywords" section.

Step 2: The documents identified in step 1 were then limited to those having the phrases "cancer and related terms" in their titles. Cancer-related terms were taken from PubMed's Medical Subject Headings (MeSH), and from a previous systematic and meta-analysis on COVID-19 in the oncology field [14-17, 42] and placed into the Scopus engine. Documents (i.e., erratum, and retracted) have been excluded (Figure 1).

Bibliometric analysis

The following bibliometric indicators were compiled using an Excel spreadsheet: total number of publications, type of publication, prolific countries, prolific institutions, prolific journals, and top-cited publications. *Reference Citation Analysis* (RCA) data is used to calculate the *Impact Index Per Article* for the top ten most cited papers. Baishideng Publishing Group Inc. owns the RCA, an open transdisciplinary citation analysis database (Pleasanton, CA 94566, USA)[43].

Visualise analysis

The network visualization maps were created using the VOSviewer (version 1.6.16) software program. [44, 45]. VOSviewer was used in our study because it is well-known as a software tool for visualizing quantitative data. VOSviewer is widely used for mapping, networking, and visualization to emphasize international collaboration and create a co-occurrence matrix to identify research hotspots based on published evidence. A node represents a certain element, such as a country or term. Stronger cooperation is shown by wider links between nodes, whereas a bigger node size suggests a large number of publications [44, 45]. The study themes in the collected literature were determined by mapping the most common terms in titles/abstracts. Using VOSviewer, it is possible to create an overlay visualization in which the most recently used author terms are shown in yellow. Terms overlay visualization was based on the occurrences and average publication per year scores.

RESULTS

Volume and types of publications

At the time of data collection (June 2202 ,21), Scopus has published 351,577 documents on COVID-19 throughout all research fields. During the study period (January 1, 2020, to June 2202 ,21), Scopus identified 7,015 papers on cancer and COVID-19 which was categorized into ten types. Among them, “Article” accounted for 57.59% of the total publications (4040 articles) and was the most frequent type, followed by letters to the editor ($n = 1061$; 15.12%), and reviews ($n = 936$; 13.34%). The remaining publication types were 978 documents (13.94%).

Contributions of countries to global publications

We ranked ten high-output countries according to the number of publications (Table 1). The United States published the most articles (2025; 28.87%), followed by Italy (964; 13.74%), the United Kingdom (839; 11.96%), and China (538; 7.67%). Figure 2 depicts a network map of the major participating countries' international research collaborations on cancer and COVID-19-related literature.

Active institutions/organizations

Table 2 shows the top ten active institutions. *University of Texas MD Anderson Cancer Center* ($n = 205$, 2.92%) ranked first, followed by the *Memorial Sloan-Kettering Cancer Center* ($n = 176$, 2.51%) and the *Harvard Medical School* ($n = 155$; 2.21%). The majority of active institutions were from the USA ($n=4$), followed by Italy ($n=3$), Canada ($n=1$), France ($n=1$), and India ($n=1$).

Active journals

For cancer and COVID-19-related literature, Table 3 shows the top ten active journals. The *European Journal of Cancer* ($n = 106$, 1.51%) ranked first, followed by the *Frontiers in Oncology* ($n = 104$, 1.48%), *Cancers* ($n=102$, 1.45%), and *Pediatric Blood and Cancer* ($n=95$; 1.35%).

Top cited publications

Table 4 Lists the top ten most cited works in the field of COVID-19 and cancer, ranked by total citations. The citations in the top ten ranged from 2498 to 340^[9-12, 46-51]. Among the top 10 papers by total citation frequency, Liang *et al* ^[52], published in *The Lancet*

Oncology in 2020, had the greatest overall citation frequency (number of citations=2498). The *impact index per article* of the ten most cited articles ranged from 118.5 to 1017.0 (Table 4).

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Research themes in cancer and COVID-19-related literature

Mapping the most often appearing terms in the title/abstract fields of publications in cancer and COVID-19 with a minimum occurrence of 100 resulted in 253 terms being distributed into two clusters corresponding to the two primary study topics (Figure 3). The clusters are “cancer care management during the COVID-19 pandemic” (cluster 1, red), and “COVID-19 vaccines in cancer patients” (cluster 2, green); (Figure 3). The guideline, emergency, procedure, safety, process, recommendation, guidance, approach, and care are the most often used terms in cluster 2. The most often used terms in cluster 2 are vaccine, vaccination, immunotherapy, and development.

The evolution of color from dark blue to yellow represents the variation of the hot topic over time. As shown in Figure 4, researchers focused on topics related to COVID-19 vaccines in cancer patients during the last year and have become the hot research topics, attracting increasing attention.

DISCUSSION

This is the first bibliometric study in the field of cancer to assess and visualize COVID-19 research. We reviewed a total of 7,015 publications from the Scopus database, and we present a detailed analysis of worldwide contributions and hotspots in COVID-19 and cancer research during the early stages of the epidemic. According to our study, the growing number of publications in cancer and COVID-19-related literature indicates that this topic is receiving much attention. During the COVID-19 pandemic, the popularity of sustainable development research has increased. The number of publications indicates that as the epidemic expands internationally, more countries are impacted, which has led to an increase in researchers paying attention to the pandemic's influence on sustainable development [52].

One of the key hot issues in the current study was the “Cancer care management during the COVID-19 pandemic”. According to several studies, the probability of developing COVID-19 in cancer patients is considered twofold higher than in the normal population. Therefore, oncologists should employ appropriate therapeutic methods in the event of a pandemic, weighing the risks of mortality from COVID-19 against the risks and benefits of continuing anticancer therapy [53-55]. Additionally, managing patients efficiently during pandemics or big crises should be a key component of the cancer care continuum. Common immunosuppressive treatments are likely to make cancer patients more vulnerable to COVID-19-related severe outcomes. Although recent studies of immunocompromised people suggest that outcomes may be less severe, several malignancy studies show a link between increased fatality rates [12, 56]. These risks are likely to differ depending on the type of cancer treatment or types of cancer [46, 50, 57]. According to the findings from a large systematic review and meta-analysis [58], it was shown that cancer is a comorbidity in between 1 and 2% of COVID-19 patients who are hospitalized in China, and 5 to 7% of patients in Western nations. Based on these findings, it appears that the subjects clinically appear the same as normal individuals, and early research has shown that patients with cancer and COVID-19 have a greater in-hospital mortality risk.

Thus, this also minimizes harm in the event of a future pandemic, but it also empowers the gains generated by the current one to improve overall health care delivery for all cancer patients and, by leveraging the efforts of many organizations across the cancer care stakeholders, helps all patients receive the highest-quality care while simultaneously fostering cooperation on a global scale [59, 60].

Another hot subject is the COVID-19 vaccine in cancer patients. Since the pandemic's early stages, patients with cancer have been designated as a high-risk group for COVID-19 infection [61, 62]. Therefore, the safety and effectiveness of COVID-19 vaccination in immunosuppressed persons must be better understood urgently, since excluding them and other susceptible groups from continuing trials of COVID-19 vaccines would consequence to in inaccurate prognostic health models, which will impact subsequent

pandemic waves [63,64]. Given the significant risk of morbidity and death from COVID-19 in cancer patients, current information on the safety and efficacy of the approved COVID-19 vaccinations in these patients is limited. However, the benefits likely outweigh the risks of vaccine-related adverse effects [65].

Published documents that are often cited have a large academic influence. Table 4 Lists the ten cancer and COVID-19-related documents with the highest citation frequency. The most frequently cited paper on the subject is “Cancer patients with SARS-CoV-2 infection: a nationwide analysis in China,” published in *The Lancet Oncology* and cited 2498 times. This prospective observational study found that cancer patients were more likely to get an infection of SARS-Cov-2, require mechanical ventilation, and have an increased mortality risk [46]. It also showed that the clinical conditions of cancer patients got worse more rapidly than that of the other populations [46]. The paper by Zhang *et al* [47], which was published in *Annals of Oncology*, was the second most cited article. This study aimed to describe the clinical characteristics of COVID-19 patients who had cancer. The results revealed that more than 80% of patients had a dry cough, low lymphocyte count, high body temperature, low protein levels, and high value of inflammatory markers (C-reactive protein). In addition, patients who received anticancer therapy during the last two weeks were more likely to have serious consequences.

The third highest cited paper, published in *Journal of Thoracic Oncology* [49], analysed two lung cancer tissue specimens of patients with COVID-19 and showed multinucleated giant cells, exudate-containing proteins, and central reactive hyperplasia of pneumocytes, along with infiltrated patches of inflammatory cells. The paper by Kuderer *et al* [12], which was published in the *Lancet*, was the fourth most cited article. This cohort analysis of 928 cancer patients diagnosed with COVID-19 noticed that male gender, smoking, old age, having \geq two medical conditions, use of chloroquine and azithromycin, cancer status, and performance situation were the determinants of death during one month. However, the types of malignancy or antitumor treatments used did not predict the death rate.

The paper by Dai *et al* [9], which was published in *Cancer Discovery*, was the fifth most cited article. The study was carried out to compare COVID-19 cancer patients *vs* non-cancer patients concerning susceptibility to COVID-19. The risk of serious outcomes, including admission to the intensive care unit, developing serious symptoms, invasive ventilation, or death, was higher in cancer patients than in non-cancer cases. Hematologic malignancies, lung cancer, and metastatic tumors were the most frequent types of cancer to have such events.

The paper by Yu *et al* [50], which was published in *JAMA Oncology*, was the sixth most cited article. According to this study, which was conducted in one center in China, the risk of contracting COVID-19 among oncology patients was found to be 0.79%. In addition, the subgroup analysis revealed a greater rate of SARS-Cov-2 infection in non-small cell lung cancer patients over 60 years old compared to those under 60.

The seventh most cited article was by Maringe *et al* [48] and published in the *Lancet Oncology*. According to this study, the COVID-19 pandemic in the UK is predicted to increase the number of preventable cancer deaths in England significantly. The pandemic of COVID-19 is predicted to impact cancer patients significantly, and urgent policy initiatives are needed to address the backlog in regular diagnostic services. The paper by Lee *et al* [10], which was published in the *Lancet*, was the eighth-most cited article. The outcomes of this study revealed a high mortality rate among COVID-19 patients with active malignancy (28%). The mortality rate was significantly associated with old age, male gender, and other diseases. However, getting anticancer treatment within four weeks of being diagnosed with SARS-CoV-2 infection was not related to a mortality rate.

The paper by Mehta *et al* [11], which was published in *Cancer Discovery*, was the ninth most cited article. This study reported a mortality rate of 28% (61/218) among COVID-19 cancer patients, which were distributed as 20 deaths of blood cancer (37%) and 41 of solid cancer (25%). The predictors of mortality were advanced age, presence of other medical conditions, a high level of inflammatory markers, and admission to the intensive care unit.

The tenth most cited article was by Feldmann *et al* [51] and published in the *Lancet*. This study revealed that tumor necrosis factor (TNF) is considered one of the main targeted therapies for certain inflammatory diseases, such as rheumatoid arthritis. Importantly, COVID-19 has a feature of inflammatory process with a role of TNF, indicating a possible benefit of using anti-TNF agents in COVID-19 patients. Moreover, no adverse outcome was found in COVID-19 patients who used anti-TNF therapy. Thus, there is an urgent need for clinical trials of anti-TNF treatment targeting COVID-19 patients.

Strengths and Limitations

Publications in cancer and COVID-19-related literature were assessed and analyzed comprehensively and objectively using the largest abstract and citation database containing peer-reviewed research. Although this is the first bibliometric investigation of COVID-19 in the field of oncology, there are certain limitations: (1) The search was conducted on June 21, 2022, and included all documents from January 1, 2020, up to June 21, 2022, but the Scopus database would have been open for new documents from 2022, so this part was omitted; (2) only publications containing the terms related to cancer in the title were retrieved; (3) and because the search was limited to the Scopus indexed journals, a few publications not included in the Scopus were missed. Other bibliometric studies have also noted some limitations [35, 66, 67].

CONCLUSION

In conclusion, this is the first bibliometric analysis to look into the present state and upcoming hot themes connected to cancer with COVID-19 infection and vice versa using VOSviewer during the epidemic's early stages. The top five most productive countries reporting high research on cancer and COVID-19-related literature are the USA, Italy, the UK, China, and India. In terms of publications in this discipline, the University of Texas MD Anderson Cancer Center and the Memorial Sloan-Kettering Cancer Center are the most prolific institutions. The results of the present bibliometric analysis revealed that most hot research topics have evaluated “cancer care management during the COVID-19 pandemic”, and “COVID-19 vaccines in cancer patients”. The emergence

of hot themes connected to cancer and COVID-19 infection may aid researchers in identifying new research areas in this field.

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