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# COVID-19 Pandemic and Its Impact on Cancer Patients: A Bibliometric Analysis of Recent Studies

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## ABSTRACT

*Cancer is one of the dreaded diseases for which no drugs have been invented so far for its complete cure. While the world is advancing so fast with the advancement of science and technology, at the same time, new dreaded diseases continue to emerge around the world. One such global pandemic disease currently witnessing is COVID-19. No exact medicine has been developed to control and cure this new pandemic which has a serious impact on aged persons; patients of diabetics, asthma, cancer, pneumonia, etc. Some recent and current studies conducted around the world have shown us many facts about this. The present study is to conduct a bibliometric analysis of 1457 scholarly communications on the impact of COVID-19 related to the Cancer indexed in the Web of Science (WoS) Core Collection database which has been retrieved.*

Keywords: COVID-19, Cancer, Web of Science, Bibliometrics, Biblioshiny, VOSviewer, SARS-CoV-2, Pandemic

## INTRODUCTION

The cases of patients with pneumonia of unknown cause detected in Wuhan City, China on December 21, 2019, have been reported by Wuhan Municipal Health Commission, China to the WHO China Country Office on December 31, 2019. The outbreak was declared as a Public Health Emergency of International Concern on January 30, 2020, by WHO. Thereafter, on February 11, 2020, WHO named it “COVID-19”. The rate of spreading of pandemic disease has become very high and fast (Ibohal Singh, 2020). The first infection with the severe acute respiratory syndrome (SARS-CoV-2) that leads to coronavirus disease (COVID-19) has now grown substantially increasing day by all over the World (Wu & McGoogan, 2020; Hanna *et al.*, 2020; Zhou *et al.*, 2020; Liang *et al.*, 2020). COVID-19 has been related to outbreaks of asymptomatic infections, severe viral pneumonia, acute syndrome of respiratory difficulty and death (Hanna *et al.*, 2020). As of 23<sup>rd</sup> January 2021, there have been 96,877,399 COVID-19 confirmed cases reported in 224 countries (*WHO Coronavirus Disease (COVID-19) Dashboard* 2021). Older people and those dealing with underlying medical problems, such as cardiovascular disease, diabetes, chronic respiratory disorders and cancer, continue to experience serious illness (WHO, *Coronavirus* 2020). There is clear evidence that older age has more symptoms of COVID-19 and adverse effects than earlier age; for cancer patients, this consideration is highly relevant (Hanna *et al.*, 2020). Having a major impact on cancer

patients, the community of these cases currently faces many difficult problems and other crisis. In this current COVID-19 pandemic, the safety of patient with cancer has raised. Two fundamental problems of patient safety were raised, firstly, patients with cancer must leave their homes to visit the cancer clinic and thereby possibly expose themselves to infection. Second, cancer treatments themselves can predispose patients to the more serious harmful effects of COVID-19 (Zhou *et al.*, 2020; Liang *et al.*, 2020; Hanna *et al.*, 2020). In addition to improved health, cancer patients need online medical advice and proper diagnosis and care during this pandemic. Without delay, cancer treatment needs to be done patient by patient and delaying could lead a risk to the patient (Wang & Zhang, 2020).

With a growing interest in COVID-19 research worldwide, many research communications have come upon the issue. The present paper is an attempt to assess the trends of research on COVID-19 and its impact on cancer treatment taking into account the just past scholarly communications indexed in Web of Science Core Collection Database. It addresses the knowledge gap and evaluates the characteristics of the current body of literature on COVID-19 and cancer research identifying the contributing authors, institutions and countries associated with this burning issue of global concerned.

## **SOME JUST PAST AND RECENT STUDIES**

Some leading studies are being reviewed here. ElHawary *et al.*, (2020) made a study on the top 50 cited COVID-19 related publications that appeared early during the pandemic. Tao *et al.* (2020) conducted a bibliometric analysis of published documents based on coronavirus from 2000 to 2020 to identify the most productive sources, countries, institutions, authors and keywords. In another bibliometrics study, Askun and Cizel (2020) studied the mixed methods for twenty years regarding the most cited countries, keyword plus cloud, co-occurrence network, co-citation, author collaboration using the R programming language. The bibliometrics analysis conducted by Xie *et al.* (2020) provides a basic worldwide overview of research publications on atlantoaxial spine surgery based on the Web of Science and VOSviewer. Dwivedi *et al.* (2017) studied the papers on male breast cancer which were indexed in Science Citation Index-Expanded and found that publication in this area has steadily been increased. Chahrour *et al.* (2020) in their bibliometrics study on trends of COVID-19 research since its outbreak using PubMed database and the World Health Organization (WHO) database have shown that among the countries, China produced the highest number of publications. Zhai *et al.*, 2020 also have studied the research progress of the coronaviruses. While He *et al.* (2020) analyzed the 100 most-cited articles in the field of urological surgery, bibliometrics analysis on cancer was carried out by different researchers (Mainwaring *et al.*, 2020; He *et al.*, 2020; Shi *et al.*, 2020; Yang *et al.*, 2019; Özen Çınar, 2020; Moral-Munoz *et al.*, 2019). Bibliometrics analysis on the other related areas is also conducted recently (Cancino *et al.*, 2019; Ahmi *et al.*, 2019).

## **OBJECTIVES OF THE STUDY**

The present study has been taken up with the objectives to

1. Assess the trends of research on COVID-19 and its impact on cancer patients;
2. Aware the characteristics of the scholarly communications;
3. Understand the contributing researchers/authors;
4. Know the institutions and countries associated with such studies; and
5. Familiar with most relevant sources and highly cited papers.

## **SCOPE AND METHODS**

The present study covers scholarly communications on COVID-19 and its related aspects particularly its impact on Cancer patients published worldwide. The data about the study has been searched, identified and downloaded from Clarivate Analytics Web of Science (WoS) Core Collection Database. For the purpose, an Advanced Search Strategy was launched and conducted on 23<sup>rd</sup>, 2021, by using search terms provided

by MeSH Browser of U.S. National Library of Medicine “TI = (COVID-19\* OR 2019-nCoV disease\* OR 2019 novel coronavirus disease\* OR Coronavirus disease-19\* OR Coronavirus disease 2019\* OR COVID-19 virus disease\* OR Novel coronavirus disease 2019\* OR SARS-CoV-2 disease\*) AND TI = (Cancer\* OR Oncology\* OR Carcinoma\* OR Malignancy\* OR Adenocarcinoma\* OR Adenoid cystic carcinoma\* OR AIDS malignancies\* OR Blastomas\* OR Leukemia\* OR Melanoblastoma\* OR Melanoma\* OR Renal cell carcinoma\* OR Rhabdomyosarcoma\* OR Sarcoma\* OR Squamous cell carcinoma\* OR Teratocarcinoma\* OR Toxohormone\* OR Benign-Neoplasms\* OR Malignant Neoplasms\* OR Neoplasia\* OR Neoplasm\* OR Tumors\*)”. Documents published and indexed up to 31<sup>st</sup> of December 2020 has been used for the study. Documents such as Early Access and Correction were excluded from the search and analysis. A total of 1457 publications fulfilled the desired search query. The data exported in plaintext (.txt) file format from the database is used as the data source. The R Package Bibliometrix (*Biblioshiny*) (Aria & Cuccurullo, 2017) and VOSviewer software (Van Eck & Waltman, 2009) are used to analyze and visualize the data.

## ANALYSIS, FINDINGS AND DISCUSSION

### Basic Data and Document Types

The bibliometric profile of the studies concerning COVID-19 and Cancer constitutes the main data source for the present study which are found in different types of documents. Table 1 and Table 2 give the details of the data sources of the papers under study and their types. Table 1 represents the bibliometric profile of global COVID-19 and Cancer researches conducted around the world during the period 2020. The data sources imported by using Biblioshiny include 1475 different types of documents which were contributed from 375 sources having 15151 references contributed by 9300 authors/researchers. However, the appearances of these authors are found to be 11979. As shown, of the 1457 documents considered for the study there are 99 single-authored and 9201 multi-authored documents. On the other hand, in author collaboration, there are 126 single-authored documents, and 0.157 documents per author, the authors per document constitute 6.38. Again, the rate of the co-authors per document is 8.22, while the collaborative index of all the 1457 papers being 6.91, as Table 1 highlights.

**Table 1. Bibliometric profile on COVID-19 and cancer research**

<b>Description</b>	<b>Results</b>
Timespan	2020:2020
Sources (Journals, Books, etc)	375
Documents	1457
Average citations per documents	5.209
Average citations per year per doc	2.609
References	15151
Keywords Plus (ID)	917
Author's Keywords (DE)	1261
Authors	9300
Author Appearances	11979
Authors of single-authored documents	99
Authors of multi-authored documents	9201
<b>AUTHORS COLLABORATION</b>	
Single-authored documents	126
Documents per Author	0.157
Authors per Document	6.38
Co-Authors per Documents	8.22
Collaboration Index	6.91

As regards the document types, as the following Table 2 shows, there are seven different types as retrieved by the Biblioshiny tool. The highest number of document type available is *Article* (31.50%) followed by *Letter* (22.10%), *Editorial material* (21.21%), *Meeting Abstract* (14.28%) and so on.

**Table 2. Distribution of documents by types**

Document Types	Frequency	Percentage (%)
Article	459	31.50
Letter	322	22.10
Editorial Material	309	21.21
Meeting Abstract	208	14.28
Review	134	9.20
News Item	23	1.58
Retraction	2	0.14
<b>Total</b>	<b>1457</b>	<b>100.00</b>

### Highly-Cited Papers

The following Table 3 and Figure 1 show the characteristics and visualization of the most highly cited and productive papers whose Global Citation Score (GCS) ranging from 133-376 which received during the study period. As seen, the paper “*Pulmonary Pathology of Early-Phase 2019 Novel Coronavirus (COVID-19) Pneumonia in Two Patients with Lung Cancer*” has received 376 GCS making the most highly-cited article followed by the paper “*Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, China*” with 340 GCS. The third highly-cited article “*Managing Cancer Care during the COVID-19 Pandemic: Agility and Collaboration toward a Common Goal*” on the other hand, got 196 GCS. The Total Citation per Year (TCPY) for the first three top highly cited articles also follows in a similar pattern as 188, 170 and 98 respectively. However, the Local Citation Score (LCS) is lowest in case of the top GCS paper with score 12 only, whereas LCS of the second and fifth-ranked papers being 154 and 93 respectively.

**Table 3. Top-10 Highly cited papers**

Title of the Paper	Author (s); Year & Source	LCS	GCS	TCPY
Pulmonary Pathology of Early-Phase 2019 Novel Coronavirus (COVID-19) Pneumonia in Two Patients With Lung Cancer (Tian <i>et al.</i> , 2020)	Tian <i>et al.</i> ; 2020, J Thorac Oncol	12	376	188
Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, China (Zhang <i>et al.</i> , 2020)	Zhang <i>et al.</i> ; 2020, Ann Oncol	154	340	170
Managing Cancer Care During the COVID-19 Pandemic: Agility and Collaboration Toward a Common Goal (Ueda <i>et al.</i> , 2020)	Ueda <i>et al.</i> ; 2020, J Natl Compr Canc Ne	78	196	98
Patients with Cancer Appear More Vulnerable to SARS-CoV-2: A Multicenter Study during the COVID-19 Outbreak (Dai <i>et al.</i> , 2020)	Dai <i>et al.</i> ; 2020, Cancer Discov	85	195	97.5
Clinical impact of COVID-19 on patients with cancer (CCC19): a cohort study (Lee <i>et al.</i> , 2020)	Kuderer <i>et al.</i> ; 2020, Lancet	93	187	93.5
Risk of COVID-19 for patients with cancer (Yang Xia <i>et al.</i> , 2020)	Xia Y <i>et al.</i> ; 2020, Lancet Oncol	74	169	84.5

Risk of COVID-19 for patients with cancer (Wang & Zhang, 2020)	Wang <i>et al.</i> ; 2020, Lancet Oncol	68	163	81.5
A Practical Approach to the Management of Cancer Patients During the Novel Coronavirus Disease 2019 (COVID-19) Pandemic: An International Collaborative Group (Al-Shamsi <i>et al.</i> , 2020)	Al-Shamsi HO <i>et al.</i> ; 2020, Oncologist	52	139	69.5
Case Fatality Rate of Cancer Patients with COVID-19 in a New York Hospital System (Mehta <i>et al.</i> , 2020)	Mehta <i>et al.</i> ; 2020, Cancer Discov	66	136	68
COVID-19 mortality in patients with cancer on chemotherapy or other anticancer treatments: a prospective cohort study (Lee <i>et al.</i> , 2020)	Lee <i>et al.</i> ; 2020, Lancet	62	133	66.5

\*LCS= Local Citation Score; GCS = Global Citation Score; TCPY= Total Citation Per Year

The data visualization of the above Table 3 made by VOSviewer also indicates the ranges of the citation scores of the papers under discussion.

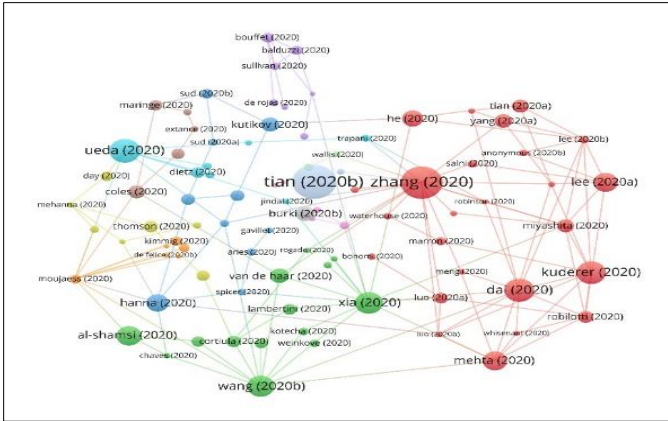


Figure 1. Highly cited paper

Sources and Impact Factor

The total analysed 1457 publications under study were retrieved from 375 journal sources. Of these 375 journals, the most productive journal having a maximum of 107 publications were from the journal *Annals of Oncology* with 616 citations received, followed by *Clinical Cancer Research* with 73 publications and 23 citations and the third most published sources are from the journals *Pediatric Blood & Cancer* with 46 publications and 192 citations. Table 4 and Figure 2 give us the most productive 10 journals publishing the maximum articles 107, 73, 46 and 39, and so on. However, in terms of the citations received by the articles, the journal *Lancet Oncology* in 5<sup>th</sup> rank has 935 citations in 36 publications just after the journal in rank 1.

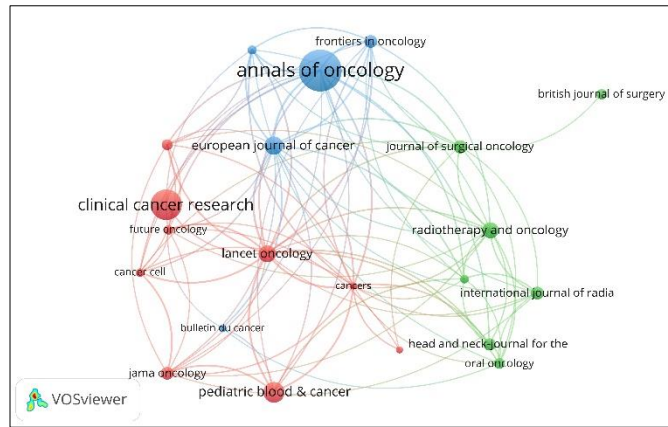
Table 4. Most Relevant Sources

Sources	Articles	Citations Received	JCR-IF (2018)
Annals of Oncology	107	616	14.196
Clinical Cancer Research	73	23	8.911
Pediatric Blood & Cancer	46	192	2.486
European Journal of Cancer	39	152	6.680
Lancet Oncology	36	935	35.386

Radiotherapy and Oncology	33	201	5.252
Journal of Surgical Oncology	26	25	3.114
Frontiers in Oncology	25	42	4.137
International Journal of Radiation Oncology Biology Physics	25	67	6.203
JAMA Oncology	25	109	22.416

\*JCR-IF = Journal Citation Report-Impact Factor

Again, contradictory to the number of articles published, the Journal Citation Report-Impact Factor (JCR-IF) is found to be highest (35.386) in respect of the journal in the 5<sup>th</sup> rank, i.e., *Lancet Oncology* followed by the journal in the 10<sup>th</sup> rank i.e., *JAMA Oncology* with JCR-IF 22.416, *Annals of Oncology*, the journal in the top rank with JCR-IF 14.196, and so on.



**Figure 2. Visualization of most relevant**

### Source Impact-Indices

The following Table 5 gives the source impact of the journals over total citation (TC) and the number of publications (NP) and different indices such as h-index, g-index and m-index.

**Table 5. Source Impact**

Source	h-index	g-index	m-index	TC	NP
Lancet Oncology	16	30	8	935	36
Annals of Oncology	9	24	4.5	616	107
Journal of Thoracic Oncology	5	11	2.5	426	11
Cancer Discovery	4	12	2	401	12
Lancet	3	6	1.5	329	6
Journal of the National Comprehensive Cancer Network	2	4	1	228	4
Radiotherapy and Oncology	7	13	3.5	201	33
Pediatric Blood & Cancer	6	13	3	192	46
Nature Reviews Clinical Oncology	5	7	2.5	185	7
Oncologist	4	12	2	176	12

( $N \geq 1$ )  $N = h$ -index value

\*TC= Total Citation; NP= Number of Publications

The top 10 journals ( $N \geq 1$ ) preferred by the researchers in the field of COVID-19 and Cancer, shares 9.35% of total sources outputs. The '*Lancet Oncology*', is found to be the most preferred journal in which 36 papers with the highest citation of 935 and with highest h-index (16) and g-index (30) were published. The journal '*Annals of Oncology*', is also found to be second most highly cited journals with 616 citations

received having h-index (9), g-index (24) and m-index (4.5). The ‘*Journal of The National Comprehensive Cancer Network*’, and ‘*Lancet*’ contributed 2 and 3 h-index which is lowest when the TC stands at 228 and 329 respectively.

## Research Productivity

The most productive and influential authors, countries and affiliations publishing the papers are presented in Table 6. As seen, 20 authors of different countries of the world contributed papers on COVID-19 and Cancer-related aspects in 2020, the number of contributions ranging from 7-14 papers. The productivity is highest in respect of the USA with 1566 number of papers, of which the *Huazhong Univ Sci and Technol* shares 89 and *Curigliano G* with 14 papers are found to be the most productive and influential author among others followed by *Peters S* with 13 papers and *Grossi F* with 10 papers, *Di Maio M*, *Lambertini M*, *Rogado J*, *Sullivan R* and *Tagliamento M* with 9 papers each contribution.

**Table 6. Productivity by authors, countries and affiliations**

Authors	NP	Countries	Freq	Affiliation	NP
Curigliano G	14	USA	1566	Huazhong Univ Sci and Technol	89
Peters S	13	Italy	1309	Univ Texas Md Anderson Canc Ctr	77
Grossi F	10	UK	734	Mem Sloan Kettering Canc Ctr	64
Di Maio M	9	France	638	Wuhan Univ	64
Lambertini M	9	China	496	Univ Toronto	56
Rogado J	9	Spain	348	Harvard Med Sch	55
Sullivan R	9	Canada	269	Univ Milan	51
Tagliamento M	9	Germany	209	Inst Canc Res	40
Ferrari A	8	Australia	193	Fdn Irccs Ist Nazl Tumori	36
Indini A	8	Netherlands	178	Univ Washington	36
Xie Ch	8	Brazil	154	Icahn Sch Med Mt Sinai	35
Barlesi F	7	India	150	Univ Calif San Francisco	35
Chopra N	7	Turkey	109	IRCCS Osped Policlin San Martino	34
Choueiri Tk	7	Switzerland	96	Univ Michigan	34
Ghidini M	7	Belgium	86	Radiat Oncol Ctr	33
Lou E	7	Singapore	62	Royal Marsden Nhs Fdn Trust	30
Magrini Sm	7	Austria	58	Univ Birmingham	30
Scotte F	7	Saudi Arabia	54	Univ Genoa	30
Wang J	7	Greece	49	Inst Curie	29
Wang L	7	Japan	42	Dana Farber Canc Inst	27

\*NP = Number of Publications

## Most Cited Countries

USA is found to be the most cited country of the top 10 countries in research productivity in COVID-19 and cancer-related aspects, the total citations and the average citations being 2216 and 6.576 respectively as the Table 7 shows.

**Table 7. Most cited top 10 Countries**

Country	Total Citations	Average Article Citations
USA	2216	6.576
China	1703	13.409
United Kingdom	984	7.569
Italy	882	4.18
France	274	4.349



Canada	182	5.688
United Arab Emirates	174	43.5
Switzerland	128	9.143
Netherlands	113	6.278
Australia	97	4.409

The USA has been followed by China with 1703 citations followed by the United Kingdom with 984 citations. The other cited countries include Italy, France, Canada and the United Arab Emirates, with 882, 274, 182 and 174 respectively. Among the top 10 most cited countries, the highest average citation per publication (43.5) is received by the United Arab Emirates followed by China (13.409), Switzerland (9.143), and United Kingdom (7.569) and so on.

Concerning the corresponding author's countries contributions, as Table 8 shows, the USA has the highest corresponding authors with 337 articles, 275 SCP and 62 MCP. Italy occupied second with 211 articles, 177 SCP and 34 MCP followed by the United Kingdom with 130 articles, 96 SCP and 34 MCP.

**Table 8. Top ten corresponding author's countries**

Country	Articles	Freq	Single country Publications(SCP)	Multiple country Publications(MCP)	MCP-Ratio
USA	337	0.268526	275	62	0.184
Italy	211	0.168127	177	34	0.1611
United Kingdom	130	0.103586	96	34	0.2615
China	127	0.101195	96	31	0.2441
France	63	0.050199	54	9	0.1429
India	48	0.038247	41	7	0.1458
Spain	35	0.027888	30	5	0.1429
Canada	32	0.025498	23	9	0.2812
Turkey	27	0.021514	25	2	0.0741
Brazil	26	0.020717	22	4	0.1538

## Keywords Analysis

### *Authors Keywords and Keyword plus*

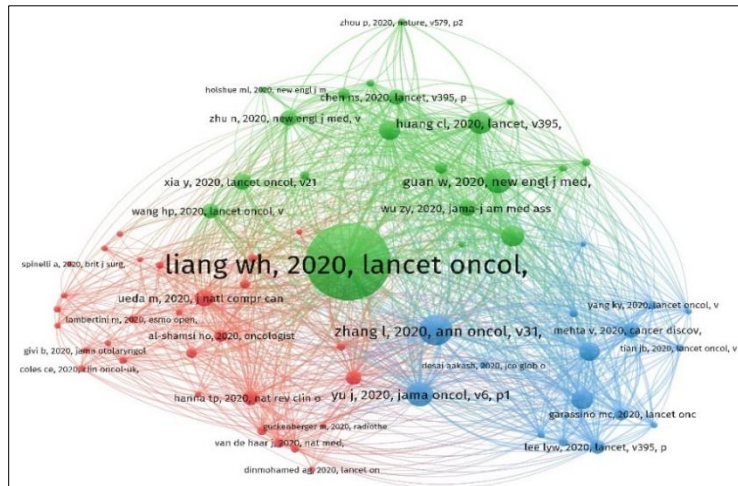
From WoS records, there are a set of 1185 author keywords of which 270 meet the threshold. From Table 9 and Figure 3, it is seen that "covid-19", "cancer" and "sars-cov-2" are the top three author keywords with a frequency of occurrences 444, 132 and 118, respectively. Keywords such as "coronavirus", "pandemic", "breast cancer" with a frequency of occurrences 85, 73 and 447 respectively also have a good performance. Further, 898 sets of keyword plus were appeared out of which 279 meet the threshold. Also, the keyword plus such as "impact" with an occurrence of 40, "china" with 37 and "pneumonia" with 34 are found as shown in Figure 4. The keywords such as "chemotherapy" and "survival" with 30 occurrences each are also found. Due to the outbreak pandemic of COVID-19 all over the world, it is evident that research on COVID-19 has been enormously increased thereby the research publication on "COVID-19 and Cancer" is gradually increasing.

**Table 9. Top 15 most representative author keywords and keyword plus**

Authors Keywords	Occurrences	Links	TLS	Keyword Plus	Occurrences	Links	TLS
covid-19	444	243	1167	impact	40	78	137
cancer	132	125	451	china	37	57	153
sars-cov-2	118	110	379	pneumonia	34	55	120
coronavirus	85	105	293	therapy	33	102	148







**Figure 6. Most cited references**

## CONCLUSION

Bibliometrics is one of the thrust areas of research in the field of Library and Information Science. The recent outbreak of COVID-19 and its impact on various fronts has been studied in different perspectives across the world, as understood from the bibliometric studies. Impact of COVID-19 on cancer patients on various issues is found to be given importance by the researchers on which studies have increasingly been carried out since recent past. The findings of the present bibliometric study throw us light on many clues on the same. A sizeable number of articles on the said aspects are found to be indexed in the Web of Science Core Collection database. Application of R Package Biblioshiny and data visualization software VOSviewer in analysing the data and their visualization could provide different perspectives of the recent and current scholarly communications on COVID-19 and its common impact on Cancer patients and their treatments as well. The authors hope to disseminate knowledge that could help researchers to recognize the important topic, study characteristics, and gaps in the literature by highlighting the features of COVID-19 and cancer related articles. As the findings and discussions made the show, the metrics of the papers on the issue indicate the significance of the studies in combating the pandemic as well as its impact on cancer patients. The trends of research on the issue and other aspects in the days to come are also expected to increase significantly.

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