**Original Article**

# A Detailed Scientometric Analysis of Global Publication Trends in COVID-19 Related Hematology and Oncology Research

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──── **Abstract** ────

**Aim:** A comprehensive scientometric analysis produced in hematology and oncology on coronavirus disease-2019 (COVID-19) research is lacking. This study presents a detailed analysis of COVID-19 related hematology and oncology literature.

**Methods:** The Web of Science (WoS) Core Collection was used for data collection. All published documents between 2020 and 2021 were included. The data exported from WoS enabled the extensive details of COVID-19 related literature in the hematology and oncology categories, including countries, institutions, authors, citations, and keywords. Scientometric interaction visualization of keywords and countries, and published journal co-authorships were created with free software. Worldwide participation of the countries in COVID-19 related hematology and oncology literature were shown by a graphic.

**Results:** The search question displayed 4761 documents. The leading type of document was original articles (34.4%). The United States of America was the number one country, publishing 32.6% of all documents on COVID-19 related hematology and oncology research, followed by Italy, the United Kingdom, China, and France. Huazhong University of Science and Technology was the most contributing institution in the literature (2.8%), followed by Harvard Medical School and Memorial Sloan Kettering Cancer Center. The journal Blood has published the most documents about this field. The average citations per item was 7.2. The most used keywords over this period were "COVID-19," "SARS-CoV-2," "coronavirus," and "cancer".

**Conclusion:** The results of the present study may assist health professionals interested in this field to better figure out the current trends in COVID-19 related hematology and oncology research worldwide, and it can provide them to reach a more accurate information in a shorter time.

**Keywords:** COVID-19, coronavirus, SARS-CoV-2, hematology, oncology

## Introduction

By late 2019, a novel virus, also named severe acute respiratory syndrome coronavirus-2, had been identified as an etiologic agent for pneumonia patients in central China (1). This novel, high-spread virus has turned into a pandemic and has forced a burden on healthcare facilities. Patients with malignancy are a susceptible group due to the immunocompromised situations caused by their malignancy treatments, the malignancy itself, and comorbidities (2). Patients with cancer are more likely to have worse outcomes (mortality ranging from 11.4% to 35.5%) when diagnosed with Coronavirus disease-2019 (COVID-19) compared to patients without

cancer (3,4). Oncology practice patterns have changed their daily routines; e.g., delay of treatment or less effective, safer treatment regimens, more frequent use of white blood cell growth factors (5). Similarly, hematological associations have rapidly published fresh interim recommendations for physicians, in particular for hematopoietic stem cell transplantation practice patterns during this COVID-19 virus outbreak time (6).

Bibliometrics analyzes publications produced in a specific discipline of academic literature to identify patterns and trends (7). Scientometrics, also known as the "science of science," is a relatively new and popular statistical discipline that investigates all aspects of scientific literature (7-9). Parallel to the spread of pandemic effects

all around the world, the scientific activity on COVID-19 has been rapidly elevated to a higher level with reduced peer-review processes and/or early access options in scientific journals. Thus, the rapid increase in COVID-19 literature in all fields of science was remarkable, especially after the second half of 2020. Though COVID-19 related publications about hematology and oncology are the trend topics of hematology and oncology practice during this pandemic, there has been no recent scientometric analysis of publications published on COVID-19 in the hematology and oncology literature.

This study presents a comprehensive analysis of academic literature about COVID-19 that has been published in hematology and oncology categories.

## Methods

### Study Design and Scientometric Analysis

This study was designed as a cross-sectional online literature analysis. The Web of Science (WoS) Core Collection (Thomson Reuters, New York, USA) was used for data collection. The data used in this study was obtained on April 29, 2021. A search question including keywords for "Covid" or "Covid-19" or "2019 novel coronavirus disease" or"coronavirus disease 2019" or "Covid-19 infection" or "SARS-CoV-2 disease". All documents from the WoS database produced between 2020 and 2021 were included in the analysis. The data acquired from the abovementioned search query has been refined to only include the "Hematology" and "Oncology" fields by selecting hematology and oncology from the "WoS Categories" option. Data was exported from WoS in two formats: "full record and cited references" and "Tab-delimited for Mac". A world map originated to show the global contribution of each country regarding publications in this category by the "Tableau Public" application, a free web source (7,10). Scientometric landscape visualization was performed by VOS viewer freeware (Leiden University, Leiden, Netherlands) (7,11). Citation counts represent all the data collected on April 29, 2021, when the WoS database search process was executed. Institutions were determined using the "Organizations-Enhanced" field. The records in England, Wales, Scotland, and Northern Ireland were merged into a single country, the United Kingdom (UK) (7).

### Statistical Analysis

Data retrieved from online literature sources has been recorded on the Excel worksheet (Office 365 for Mac). Only the descriptive statistical methods (frequencies and percentages) were used for data analysis. Due to a lack of conventional statistical comparison methods, no p-values were obtained in this study.

## Results

### Document Characteristics

The initial search query revealed 109,830 documents. After refinement for year periods and hematology/oncology categories, 4671 records were displayed during the period 2020-2021, 34.4% of which were original articles. A greater proportion of documents (2779, or 59.5%) were related to the oncology field. The documents published in 2020 were more numerous (3,624 vs. 999) than the documents published in 2021 as of the access date of this study. Oncology, hematology, cardiovascular system, radiology, and experimental research medicine were the trending research fields (64.9%, 40.3%, 10.4%, 4.8%, and 4%, respectively). The first document about this category was published in June 2020. The predominant language of the literature was English (98.7%), followed by French, German, Spanish, and Russian (0.5%, 0.5%, 0.1%, and 0.1%, respectively) (Table 1).

### The Most Influential Authors, Journals, Meetings, and Institutions

Thachik J has published the maximum number of records with 25 articles after anonymous authors in this area (Table 1). The blood was the leading journal with 191 articles, followed by Clinical Cancer Research, Annals of Oncology, British Journal of Hematology, Transfusion, Thrombosis Research, and Journal of Thrombosis and Thrombolysis (n=161, 141, 138, 135, 112, and 104 items, respectively; Table 1). The Annual Meeting of the European Society for Medical Oncology-ESMO has been found to be the leading meeting with the highest record among meetings in this field. The most prolific organizations worldwide were in China and the United States. Huazhong University of Science and Technology has published the most records among organizations, with 127 documents, followed by Harvard Medical School and Memorial Sloan Kettering Cancer Center (Table 2).

### Global Productivity

The United States of America (USA) was the leading country in COVID-19 literature in the Hematology and Oncology category and covered 32.6% of all productivity with 1523 items. Italy was the second leading country with 720 records, followed by the UK, China, and France (n=533, 513, and 298 items, respectively; Table 1). North America and Europe dominated the publication density around the world, but the least contribution to this field was observed in Africa (Figure 1).

### Citations, Keyword Analysis, and a Network of Co-authorship for Countries and Institutions

A total of 13764 (11102 without self-citations) citations have been displayed with a h-index of 78. The average

| Table 1. General characteristics of publications on COVID-19 research in hematology and oncology category | | |
|---|---|---|
| **Document Types** | **Record count** | **% of 4671** |
| Article | 1606 | 34.4 |
| Letter | 1036 | 22.2 |
| Meeting Abstract | 778 | 16.7 |
| Editorial Material | 700 | 15 |
| Review | 481 | 10.3 |
| Early Access | 387 | 8.3 |
| News Item | 39 | 0.8 |
| Correction | 30 | 0.6 |
| Retracted Publication | 1 | 0.02 |
| Retraction | 1 | 0.02 |
| **Total** | **4671** | **100** |
| **Research Areas** | **Record count** | **% of 4671** |
| Oncology | 3029 | 64.9 |
| Hematology | 1883 | 40.3 |
| Peripheral Vascular Disease | 484 | 10.4 |
| Radiology Nuclear Medicine Medical Imaging | 224 | 4.8 |
| Medicine Research Experimental | 185 | 4 |
| Immunology | 138 | 3 |
| Cardiac Cardiovascular Systems | 125 | 2.7 |
| Surgery | 111 | 2.4 |
| Pediatrics | 108 | 2.4 |
| Nursing | 105 | 2.3 |
| **The 20 most prolific authors** | **Record count** | **% of 4671** |
| Anonymous | 31 | 0.6 |
| Thachik J | 25 | 0.5 |
| Wang J | 24 | 0.5 |
| Wang Y | 23 | 0.5 |
| Curıglıano G | 22 | 0.5 |
| Lıu Y | 22 | 0.5 |
| Gupta S | 21 | 0.5 |
| Peters S | 21 | 0.5 |
| Lippi G | 20 | 0.4 |
| Van Hemelrıjck M | 20 | 0.4 |

| **The 10 most productive source titles** | **Country** | **Records** | **% of 4671** |
|---|---|---|---|
| Blood | USA | 191 | 4 |
| Clinical Cancer Research | USA | 161 | 3.5 |
| Annals of Oncology | Netherlands | 141 | 3 |
| British Journal of Hematology | UK | 138 | 3 |
| Transfusion | USA | 135 | 2.9 |

| Table 1. Continued | | | |
|---|---|---|---|
| **Document Types** | **Record count** | | **% of 4671** |
| Thrombosis Research | UK | 112 | 2.4 |
| Journal of Thrombosis and Thrombolysis | Netherlands | 104 | 2.3 |
| Pediatric Blood Cancer | USA | 100 | 2.1 |
| Journal of Thrombosis and Haemostasias | USA | 94 | 2 |
| Annals of Translational Medicine | China | 92 | 2 |
| **The top 10 countries** | **Records** | | **% of 4671** |
| USA | 1523 | | 32.6 |
| Italy | 720 | | 15.4 |
| England | 533 | | 11.4 |
| Peoples R China | 513 | | 11 |
| France | 298 | | 6.4 |
| Canada | 263 | | 5.6 |
| Spain | 249 | | 5.3 |
| India | 234 | | 5 |
| Germany | 214 | | 4.6 |
| Netherlands | 170 | | 3.6 |
| COVID-19: Coronavirus disease-2019 | | | |

citations per item was 7.2. A full-length article by Klok, F. A. et al. titled "Incidence of thrombotic complications in critically ill ICU patients with COVID-19" and published in Thrombosis Research in 2020, has gained the maximum citations (Table 3). The most used keywords over this period were "COVID-19", "SARS-CoV-2", "coronavirus", and "cancer" (Table 2). The scientometric network of keywords showed a "dichotomous pattern" in which COVID-19 was centered in the intersection (Figure 2). The USA was the most collaborative country, with 1523 documents, followed by Italy (Figure 3). The Journal of Blood and The Journal of Clinical Cancer Research were the leading source titles (Figure 4).

## Discussion

Scientometric studies display the publication trends and creativity of the countries, authors, and organizations in a certain area (7,8). Scientometrics enables the qualitative and quantitative assessment of academic literature and provides details of the most popular, active, and trending fields (7,12). Contrary to scientometrics growing popularity, there have been few articles investigating COVID-19 in the hematology and oncology fields (7).

Masjedi et al. (13) reported an overview of the oncology research of Iranian scholars between 1974 and 2019. The authors discovered an upward trend in all cancer research conducted by Iranian institutions, both in terms of productivity and citations received. However, the authors reported that complementary and alternative

medicine treatment subfields have not been well-studied in the oncology literature produced by Iran. The authors included the research records indexed in either the Pubmed, Scopus, or WoS databases, which were different from this study (13).

A report by Acevedo et al. (14) focused on the distribution and trend of hematology and oncology research in Latin America. The authors reported that the most contributing country to the hematology and oncology fields in Latin America was Brazil (60% of all published documents) (14). In contrast to this study, only the abstracts presented at 4 major hematology and oncology annual scientific meetings were analyzed. Only approximately 18% of abstracts were published as full-text articles in a median of 1 year after presentation. In contrast to this study, the network analysis between authors, keywords, countries, and institutions of all documents was absent in that study.

An interesting paper has presented the details of the European cancer research perspective regarding cancer sites and the economic wealth status of countries (15). The authors found that cancer sites (e.g., central nervous system, blood cancers) seemed to be over-researched, whereas some gastrointestinal (e.g., pancreas, esophageal) cancers were under-researched (15). Furthermore, European countries were found to be insufficient contributors to cancer research compared to their economic wealth status (15). The main distinction between this study and the aforementioned studies was

**Table 2. The 10 most productive institutions and most cited keywords on COVID-19 research in hematology and oncology category**

| Organizations | Country | Records | % of 4671 |
|---|---|---|---|
| Huazhong Univ Sci Technol | China | 127 | 2.7 |
| Harvard Med Sch | USA | 119 | 2.5 |
| Mem Sloan Kettering Canc Ctr | USA | 107 | 2.3 |
| Univ Milan | Italy | 96 | 2 |
| Univ Texas Md Anderson Canc Ctr | USA | 94 | 2 |
| Univ Toronto | Canada | 74 | 1.6 |
| Dana Farber Canc Inst | USA | 69 | 1.5 |
| Univ Washington | USA | 68 | 1.5 |
| Massachusetts Gen Hosp | USA | 61 | 1.3 |
| Univ Calif San Francisco | USA | 61 | 1.3 |
| **Keywords** | | | **Records** |
| Covid-19 | | | 1389 |
| Sars-cov-2 | | | 414 |
| Coronavirus | | | 235 |
| Cancer | | | 244 |
| Pandemic | | | 177 |
| Thrombosis | | | 125 |
| Covid$#8208 | | | 105 |
| 19 | | | 99 |
| Mortality | | | 83 |
| Cov$#8208 | | | 47 |
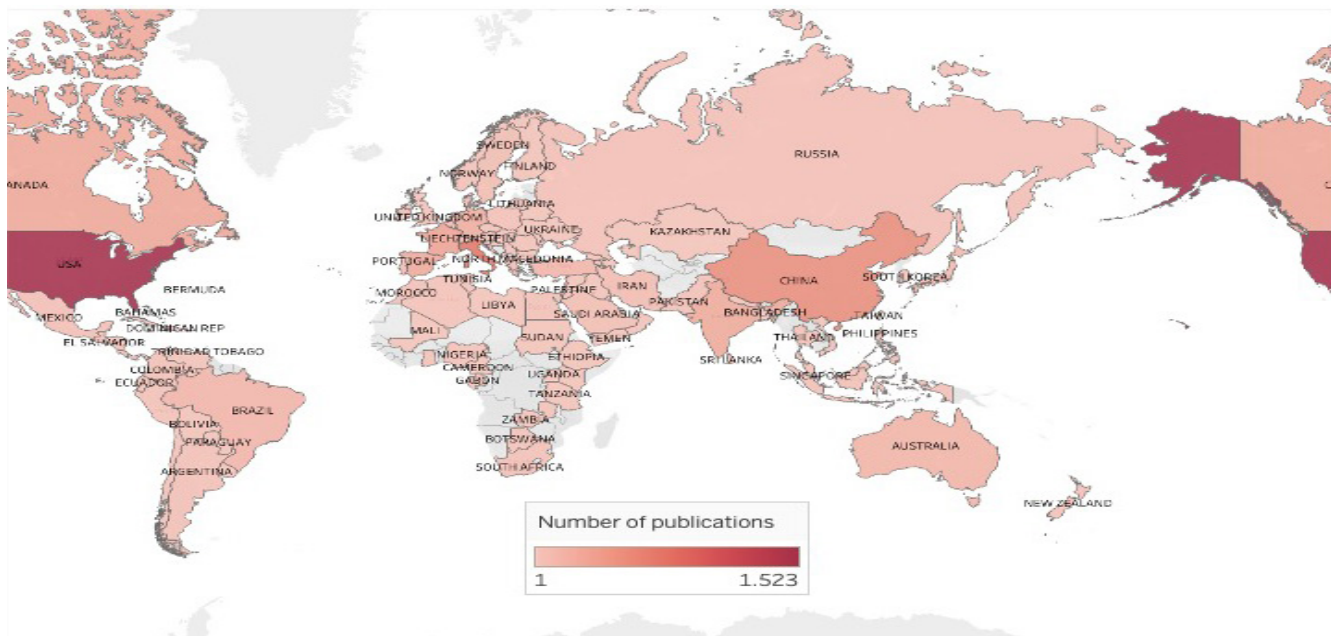


**Figure 1.** Publication density of world countries in COVID-19 related Hematology and Oncology research
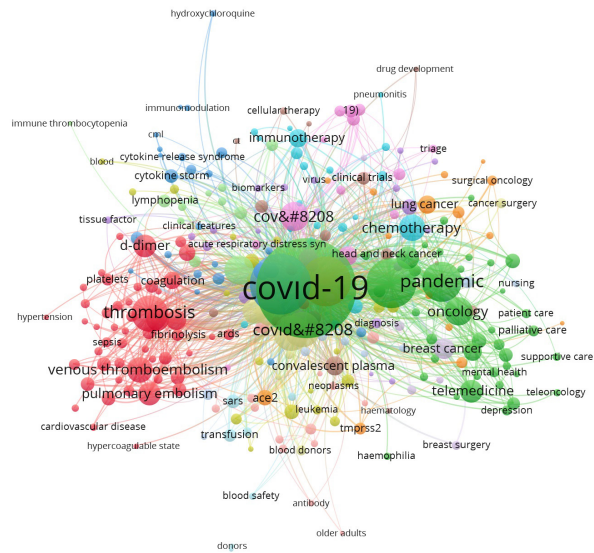COVID-19: Coronavirus disease-2019

**Figure 2.** Scientometric interaction of the most used keywords in COVID-19 related Hematology and Oncology literature
COVID-19: Coronavirus disease-2019



**Figure 3.** Scientometric interaction of the most cooperative countries in COVID-19 related Hematology and Oncology literature
COVID-19: Coronavirus disease-2019

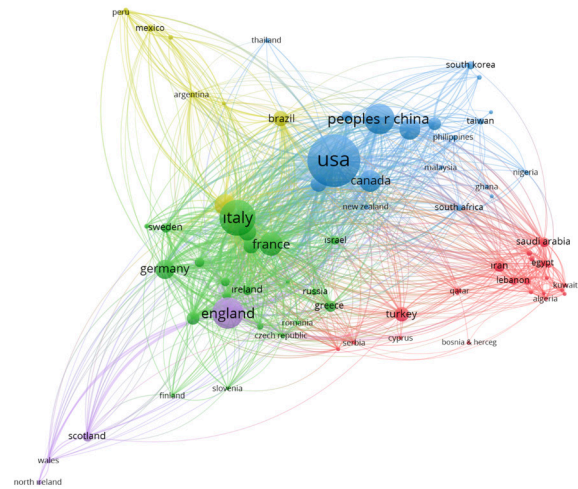| **Table 3. Most cited articles on COVID-19 literature in haematology and oncology category** | | | | | |
|---|---|---|---|---|---|
| Article | Author(s) | Journal | Year | Total citations | Average citations per year |
| Incidence of thrombotic complications in critically ill ICU patients with COVID-19 | Klok, F. A., Kruip, M. J. H. A., Van der Meer, et al | *Thrombosis Research* | 2020 | 1336 | 668 |
| ISTH interim guidance on recognition and management of coagulopathy in COVID-19 | Thachil, J., Tang, N., Gando, S. et al. | *Thrombosis and Haemostasias* | 2020 | 586 | 293 |
| Venous and arterial thromboembolic complications in COVID-19 patients admitted to an academic hospital in Milan, Italy | Lodigiani, C., Iapichino, G., Carenzo, L., et al | *Thrombosis Research* | 2020 | 584 | 292 |
| COVID-19 and its implications for thrombosis and anticoagulation | Connors, J. M., & Levy, J. H | *Blood* | 2020 | 583 | 291.5 |
| Pulmonary pathology of early-phase 2019 novel coronavirus disease-2019 (COVID-19) pneumonia in two patients with lung cancer. | Tian, S., Hu, W., Niu, L., Liu, H., Xu, H., et al | *Thoracic Oncology* | 2020 | 492 | 246 |
| Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, China | Zhang, L., Zhu, F., Xie, L., et al | *Annals of Oncology* | 2020 | 437 | 218.5 |
| Hematological findings and complications of COVID-19 | Terpos, E., Ntanasis-Stathopoulos, I., Elalamy, et al | *American Journal of Hematology* | 2020 | 417 | 208.5 |
| Angiotensin-converting enzyme 2: SARS-CoV-2 receptor and regulator of the renin-angiotensin system: celebrating the 20th anniversary of the discovery of ACE2 | Gheblawi, M., Wang, K., Viveiros, A., et al. | *Circulation Research* | 2020 | 417 | 208.5 |
| Association of inpatient use of angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers with mortality among patients with hypertension hospitalized with COVID-19 | Zhang, P., Zhu, L., Cai, J., et al. | *Circulation Research* | 2020 | 390 | 195 |
| Incidence of thrombotic complications in critically ill ICU patients with COVID-19 | Klok, F. A., Kruip, M. J. H. A., et al. | *Thrombosis Research* | 2020 | 384 | 192 |
| COVID-19: Coronavirus disease-2019, ICU: Intensive care unit, SARS-COV-2: Severe acute respiratory syndrome coronavirus-2, ACE-2: Angiotensin converting enzyme | | | | | |

**Figure 4.** Scientometric interaction of the most cooperative source titles (journals) in COVID-19 related Hematology and Oncology literature

COVID-19: Coronavirus disease-2019

that a comparison of contributing countries according to their economic status was lacking (15).

Andersen et al. (16) analyzed the global myeloma research published between 2005 and 2013. The authors reported that an annual increase of up to 43% was observed in global publication density for myeloma research (16). European countries and the USA showed the highest intra-cluster collaboration between each other (16). Similar to this study, USA-originated myeloma research clusters dominated the total productivity and citations (16).

In a bibliometric analysis of acute myeloid leukemia (AML) research conducted between 1999 and 2018, the authors reported an increasing trend in AML studies after 2009 (17). The Blood journal has published the highest number of AML studies (17). The USA and Kantarjian H were found to be the most productive countries and authors of AML research, respectively (17). Similarly, in this report, the journals Blood and USA dominated the COVID-19 research in the hematology and oncology categories.

More than 50% of the global productivity on COVID-19 in hematology and oncology category documents was achieved by the USA and a few European countries (Italy, UK, and France). Except for China, all the first 5 leading contributing countries in COVID-19 in hematology and oncology categories were developed ones. The relatively higher productivity of China could be attributed to the fact that the COVID-19 outbreak was first spread from this country to the world.

Kappi et al. (18) have recently reported a bibliometric analysis of world COVID-19 research that was comparable to this study. As of September 10, 2020, 17,133 published documents were related to COVID-19 (18). A logarithmic increase in COVID-19 research was observed as of April 29, 2021 by the time this study was conducted compared

with the Kappi et al.'s (18) report (109,830 vs 17,133). This logarithmic increase trend was also observed in the hematology and oncology categories. A total of 988 (564 in oncology and 424 in hematology) documents were related to COVID-19 as of 10 September, which has increased more than 5-folds (3029 in oncology and 1883 in hematology) in a 7-months-period (18). At two time points, the USA was the leading country regarding global productivity of COVID-19 research in this category. As the outbreak of COVID-19 has spread worldwide, China's contribution to global productivity in this category has decreased.

### Study Limitations

This study has several limitations. First, though WoS has been speculated as a more valid data source than other counterparts, the data obtained from only one data source might not represent all documents (7,19). A similar study on COVID-19 in the hematology and oncology categories was absent to achieve healthy comparisons with this report (7). However, this is the first report focusing on COVID-19 related hematology and oncology research by scientometric analysis.

### Conclusion

The results of this study may assist health professionals interested in this field to better figure out COVID-19 related hematology and oncology research worldwide. Beneficial information about dynamic and trending search topics in COVID-19 related hematology and oncology research fields may be obtained from this study. It can also contribute to researchers' access to information in a shorter time. Policymakers worldwide could better allocate their resources to improving and monitoring COVID-19-related hematology and oncology research.

**Ethics**

**Ethics Committee Approval:** Ethical approval was not applicable and not obtained for this study due to not including human or animal research.

**Informed Consent:** Informed consent was not obtained.

**Financial Disclosure:** The author received no financial support for the research, authorship, and/or publication of this article.

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