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Original Article

The Scientometric Analysis of Highly-Cited Articles in Hematology Published from 2010 to 2020

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Abstract

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Background: Hematology plays a crucial role in investigating blood disorders and their treatment. Recognizing highly cited research can guide future studies in this field. This study aims to analyze the most highly cited articles in hematology from 2010 to 2020 to uncover key contributions and trends in this discipline.

Methods: This study searched the Web of Science Core Collection, focusing on the topic of hematology, to retrieve articles from 2010 to 2020. The top 100 highly cited hematological publications were then selected for additional examination, emphasizing original research papers and reviews. Finally, the data was transferred to R4.3.1 software and analyzed with Biblioshiny.

Results: The most cited articles in the field of hematology received citations in the range of 708 to 9886. Additionally, the “Blood” Journal was the primary contributor to producing highly-cited papers by publishing 41 articles. Döhner H. and Kantarjian HM. Contributed to four papers, claiming the largest share of individual authors of the highly-cited articles. Harvard University was the primary institution that contributed to producing highly cited hematology articles. Regarding the country of the corresponding author, the USA was the primary contributor to the published articles. Ultimately, these highly-cited hematology articles' most frequent keywords and essential topics were identified.

Conclusion: Research advances and trends can be seen in highly-cited hematology articles that can advance future research topics and directions in this field. It was also determined what specialized topics are significant among researchers worldwide.

Introduction

Scientometrics is a quantitative analysis of publications to investigate the scientific impact of articles in a specific subject area and identify the characteristics of those studies (1-2). Citation analysis is one of the main tools in scientometrics,

and its findings can guide researchers in shaping their future research (3-4). Analysis of highly-cited articles reveals valuable and exciting information about scientific progress in a research field, including the impact of authors, institutions/universities,



countries, and journals on that particular subject area, and specifies in which subjects those articles have been most active (5-6).

Web of Science (WoS) is a database that provides information about the citations of articles (7). Scientometric analysis has been used to identify the most cited articles in various subject areas (1,3,8). One of the critical areas of medicine that studies blood cells and blood diseases is hematology. Numerous papers have been produced in the previous ten years due to research conducted on this topic in various clinical and laboratory settings (9). The scientometric studies in hematology focus on Brazil's scientific contributions to the field, including financial aspects and the availability of open-access articles. The difference between current research and previous articles (10-11) is in the research community and goals. This article reviews the top 100 hematology articles. It is necessary to examine the top 100 frequently cited hematological articles for many reasons.

The field of hematology has witnessed significant advancements over the past decade, with numerous high-impact articles contributing to the body of knowledge (12-13). However, there needs to be a more comprehensive scientometric analysis that evaluates the characteristics and trends of highly-cited articles in hematology from 2010 to 2020. Understanding these trends is crucial for identifying influential research, guiding future studies, and informing policy decisions. This study aims to fill this gap by conducting a detailed scientometric analysis of highly-cited hematology articles. Therefore, the present study examines 100 highly cited original and review articles in hematology.

Methods

The top 100 highly-cited reviews and original publications in the subject area of hematology published in the (WoS database) were analyzed using scientometric methods to assess their scientometric values. This study explored articles, journals, authors, institutions, Countries, and keywords. The data obtained were restricted to the WoS Core Collection. For a thorough search, this study used the WoS Categories tool to obtain all hematology-related publications (WC=hematology). The results from the Document Type section were limited to "Review Article" and "Article," the time span was set by restricting the Publication Years section to 2010 to 2020. In the next step, "Citations: highest first" was used to sort the results. Finally, 100 highly-cited reviews and original articles were chosen. The data were acquired on November 2, 2023. For all of the top 100 highly-cited publications, the "Full Record and Cited References" option was selected during data extraction, which was then saved in a "plain text" format.

Data was standardized for author profiles, affiliations, journals, and countries. Additionally, the countries of all corresponding authors were extracted from articles with multiple corresponding authors. Finally, the data were transferred to R4.3.1 software, and the results were analyzed using the bibliometrics package (Biblioshiny) (14).

Results

Figure 1 displays the Annual Scientific Production of the top 100 highly-cited hematology articles. Among these 100 papers, most articles were published in 2010 (N=19), 2020 (N=16), and 2016 (N=11), respectively.

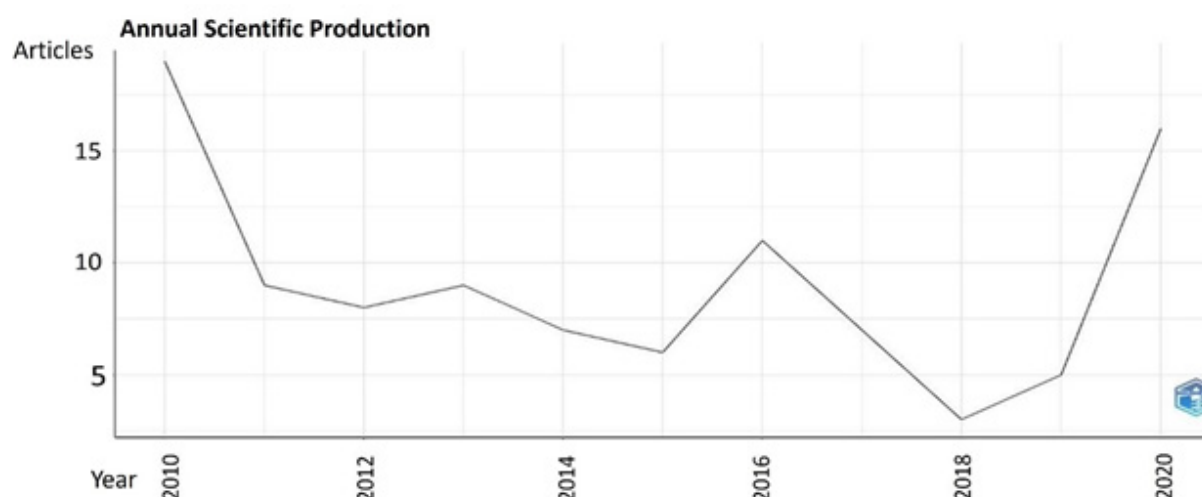


Figure 1. Annual scientific productions of the top 100 highly-cited hematology papers in 2010-2020

Figure 2 shows the association between the highly cited hematology publications by the WOS category and other categories. The graph has four clusters. Consequently,

there is a stronger correlation between peripheral vascular disease and the cardiac and cardiovascular systems, and these highly cited hematological papers.

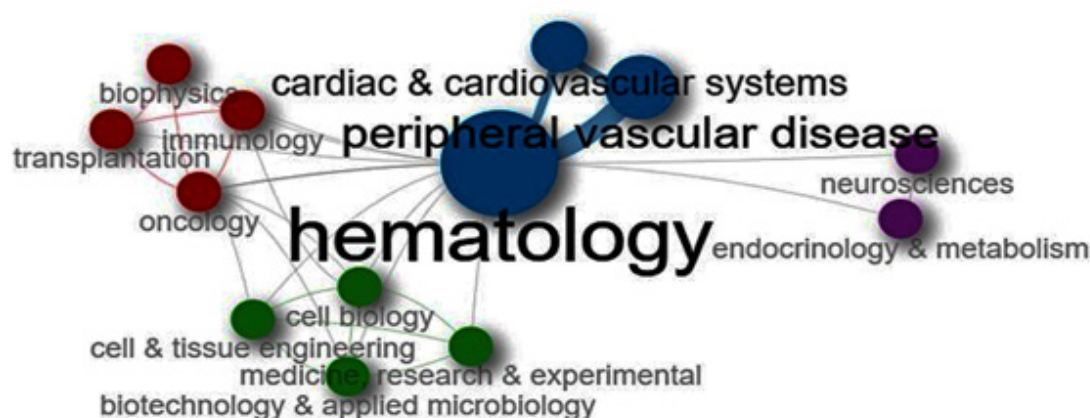


Figure 2. The relationship between the category of hematology and other categories based on the top 100 highly-cited hematology articles

Table 1 illustrates information such as the journal's name, the number of published articles in each journal, impact factor, quartile, and category rank. A total of 19 journals published the most-cited hematology papers. "Blood" (IF=20.3) published the most frequently cited publications with 41 articles, followed by 27 papers from "Circulation

Research" (IF=20.1) and "Journal of Thrombosis and Haemostasis" (IF=10.4). Among these journals, "Blood" received the most citations (n= 56,264), and "Journal of Hematology & Oncology" had the most minor citations (n= 711). Thirteen of these journals were in the first quartile (Q1), and six were in the second quartile (Q2).

Table 1. Journals with the highest shares of the top 100 highly-cited hematology articles

Rank	Journal	No.	TC ¹	IF ²	Quartile	Rank of 79
1	Blood	41	56214	20.3	Q1	3
2	Circulation Research	27	27696	20.1	Q1	4
3	Journal of Thrombosis and Haemostasis	9	10967	10.4	Q1	9
4	Arteriosclerosis Thrombosis and Vascular Biology	3	4254	8.7	Q1	12
5	Leukemia	3	2913	11.4	Q1	7
6	Biology Of Blood and Marrow Transplantation	2	2839	4.3	Q2	27
7	Stem Cells	2	1698	5.2	Q2	22
8	Thrombosis Research	2	5065	7.5	Q1	14
9	American Journal of Hematology	1	1067	12.8	Q1	5
10	Blood Cancer Journal	1	715	12.8	Q1	5
11	Bone Marrow Transplantation	1	9886	4.8	Q2	23
12	Critical Reviews in Oncology Hematology	1	1010	6.2	Q1	19
13	Cytotherapy	1	1235	4.5	Q2	25
14	Haemophilia	1	1330	3.9	Q2	30
15	Journal of Cerebral Blood Flow and Metabolism	1	1025	6.3	Q1	18
16	Journal of Hematology & Oncology	1	711	28.5	Q1	1
17	Journal of Leukocyte Biology	1	1169	5.5	Q2	21
18	Lancet Haematology	1	774	24.7	Q1	2
19	Thrombosis and Haemostasis	1	1080	6.7	Q1	16

¹ Total Citation² Impact Factor

Figure 3 displays the annual production of highly-cited hematology articles in the top three journals that published these articles. The “Blood” journal published 41 highly cited

articles, 10 of which were published in 2010. The “Journal of Thrombosis and Haemostasis” published nine highly cited articles, seven of which were published in 2020.



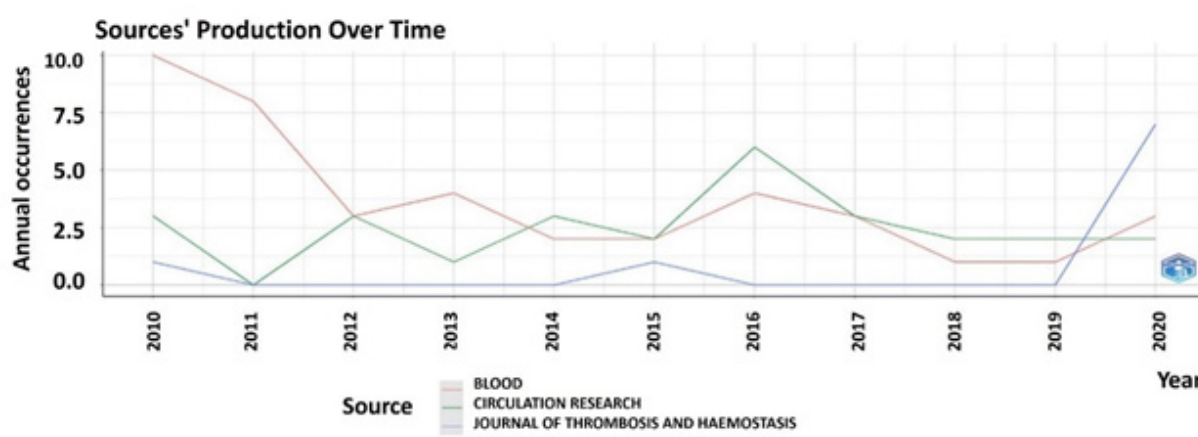


Figure 3. Publication of top three journals with the highest number of highly cited hematology articles by year of publication

Table 2 shows the authors who contributed to producing three or more articles among the top 100 highly-cited hematology articles. Among these authors, Döhner H and Kantarjian HM were the most recurring names, each producing four articles

and receiving 7,900 and 5,396 citations, respectively. Also, Bloomfield CD has received the highest number of citations (12,123) with three articles, followed by Kanda Y with one article and 9,886 citations and Cazzola M with three publications and 9,213 citations.

Table 2. Authors who published three or more articles among the top 100 highly-cited hematology papers

Rank	Authors	No. of articles	Citations	Average citations per document
1	Döhner H	4	7900	1975
2	Kantarjian HM	4	5396	3899.75
3	Bloomfield CD	3	12123	4041
4	Cazzola M	3	9213	3071
5	Dombret H	3	7021	2340.33
6	Fenaux P	3	8189	2729.66
7	Grimwade D	3	7631	2543.66
8	Sanz MA	3	7470	2490
9	Kochenderfer JN	3	2891	963.66
10	Larson RA	3	7588	2529.33
11	Niederwieser D	3	7588	2529.33
12	Tallman MS	3	7162	2387.33
13	Sekeres MA	3	4204	1401.33

Table 3 lists the top institutions and universities with the largest shares of 100 highly-cited hematology publications. With 53, 22, and 19 highly-cited publications, Harvard University, National Institutes

of Health (NIH)—USA, and Assistance Publique Hopitaux Paris (APHP) claimed the first, second, and third ranks regarding the top 100 highly-cited hematology articles, respectively.

Table 3. Institutions with the highest number of articles published among the top 100 highly-cited hematology articles

Rank	Affiliations	No. of articles
1	Harvard University	53
2	National Institutes of Health (NIH)-USA	22
3	Assistance Publique Hopitaux Paris (APHP)	19
4	University of Pennsylvania	17
5	University Paris Cite	16
6	Dana-Farber Cancer Institute	15
7	Wuhan University	15
8	Memorial Sloan Kettering Cancer Center	15
9	University of London	15
10	Harvard Medical School	14
11	NIH National Cancer Institute (NCI)	14
12	Brigham and Women’s Hospital	13
13	University of Texas System	13

Table 4 displays the distributions of the top 100 highly-cited hematology papers by the corresponding author’s nationality based on the measures of multiple countries publications (MCP) and single-country publications (SCP). These 100 papers were written by contributors from a total of 15 countries. The most productive country was the USA (N=57: SCP=34 and MCP=23), which produced over half of the articles, followed by the UK (N=10: SCP=4 and MCP=6), Germany (N=9: SCP=4 and MCP=5), France (N=8: SCP=1 and MCP=7), and other countries. Japanese

authors published their articles only in the SCP format, and Canada, Denmark, Greece, India, New Zealand, and Spain have published their articles in the MCP format.

Figure 4 shows the nations that contributed to the creation of the 100 most-cited hematology publications. The two largest clusters contained 9 and 6 countries, respectively. Additionally, Italy, France (cluster 1), and the United States (cluster 2) were the primary producers of 100 highly-cited articles in the field of hematology.

Table 4. Countries of the corresponding authors of 100 highly-cited hematology articles from 2010 to 2020

Rank	Country	Articles	SCP	MCP
1	USA	57	34	23
2	United Kingdom	10	4	6
3	Germany	9	4	5
4	France	8	1	7
5	China	7	5	2
6	Italy	5	3	2
7	Netherlands	4	3	1
8	Canada	4	0	4
9	Australia	2	1	1
10	Denmark	1	0	1
11	Greece	1	0	1
12	India	1	0	1
13	Japan	1	1	0
14	New Zealand	1	0	1
15	Spain	1	0	1

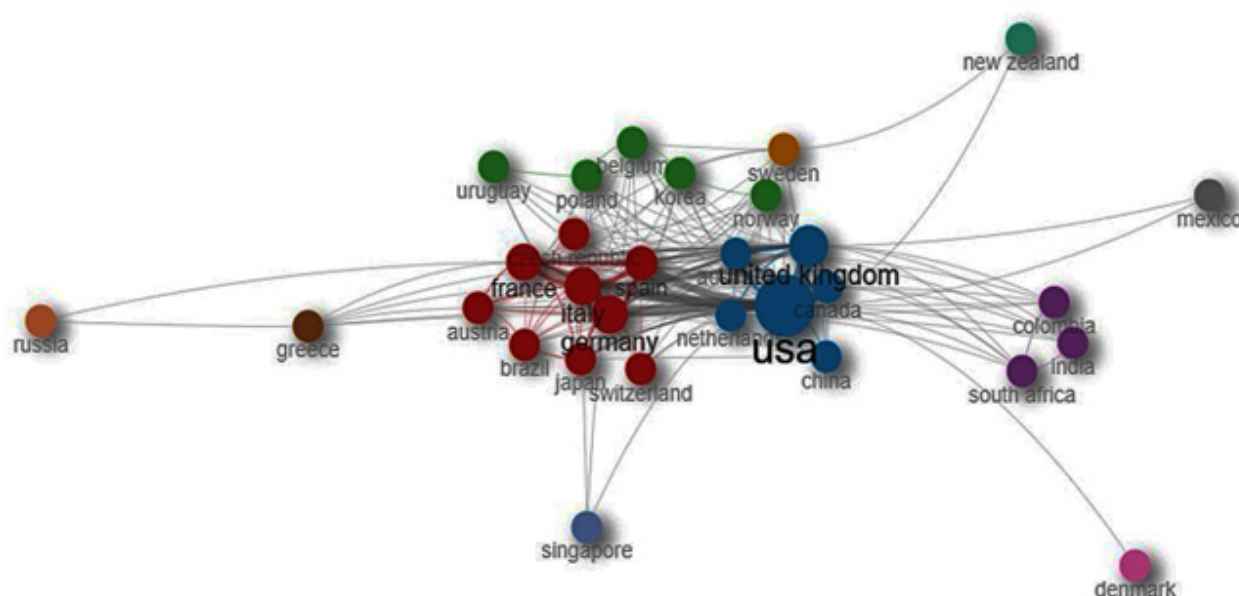
**Figure 4.** Collaboration network of countries that had published the top 100 highly-cited hematology articles

Figure 5 reveals the Tree-Map of the Keyword Plus, reflecting that smooth muscle cells and stem cell transplantation (each with eight appearances)

and acute myocardial infarction, cancer, and expression (each with seven repetitions) were the most frequently used keywords.



Figure 5. The Tree-Map of the Keyword Plus in the top 100 highly-cited hematology articles

Figure 6 shows the occurrence of keywords in the 100 most cited hematology articles. In 2010, the keywords “Acute Myocardial-Infarction” and Expression had the highest number of repetitions with four times. The seven repetitions of the keyword

“Acute myocardial infarction” occurred in the first five years of this decade (2010, 2013, and 2014). The most continuous keywords recorded during this period were related to the word “Stem-Cell Transplantation,” which constantly occurred from 2013 to 2018.

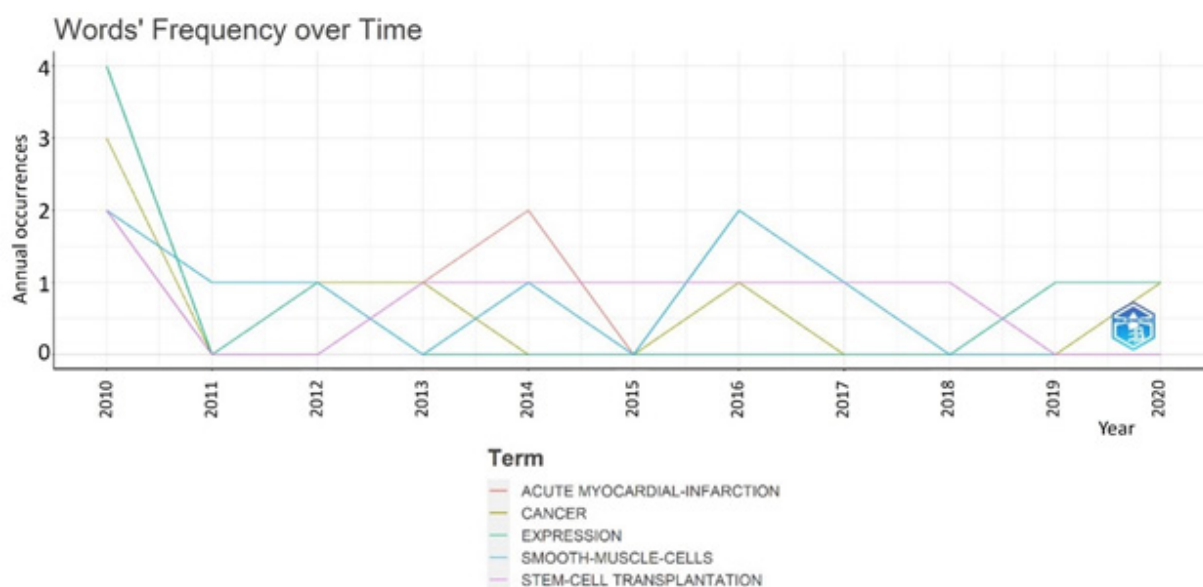


Figure 6. Occurrence of top 5 keywords by year in highly cited hematology articles

Further analysis was conducted to identify the most frequent research themes (Figure 7). A strategic diagram showing a thematic map based on density (y-axis) and centrality (x-axis) of research themes was drawn. The centrality measures the importance of the selected theme, and density measures the development of the chosen item. The graph was divided into four compartments. The themes that appeared on the lower-left part were either emerging

or declining. These new themes could emerge into more developed themes or drop from the research area. The themes in the lower right part of the thematic map (i.e., low density but high centrality) constituted basic or transversal themes attracting considerable research efforts. The upper left of the map represents themes with high density but low centrality, representing highly developed but isolated themes. Finally, the upper-right part represented

themes with high density and high centrality. These themes are considered well-developed and essential

motor themes. The size of the thematic map depends on the factors that come under various themes.

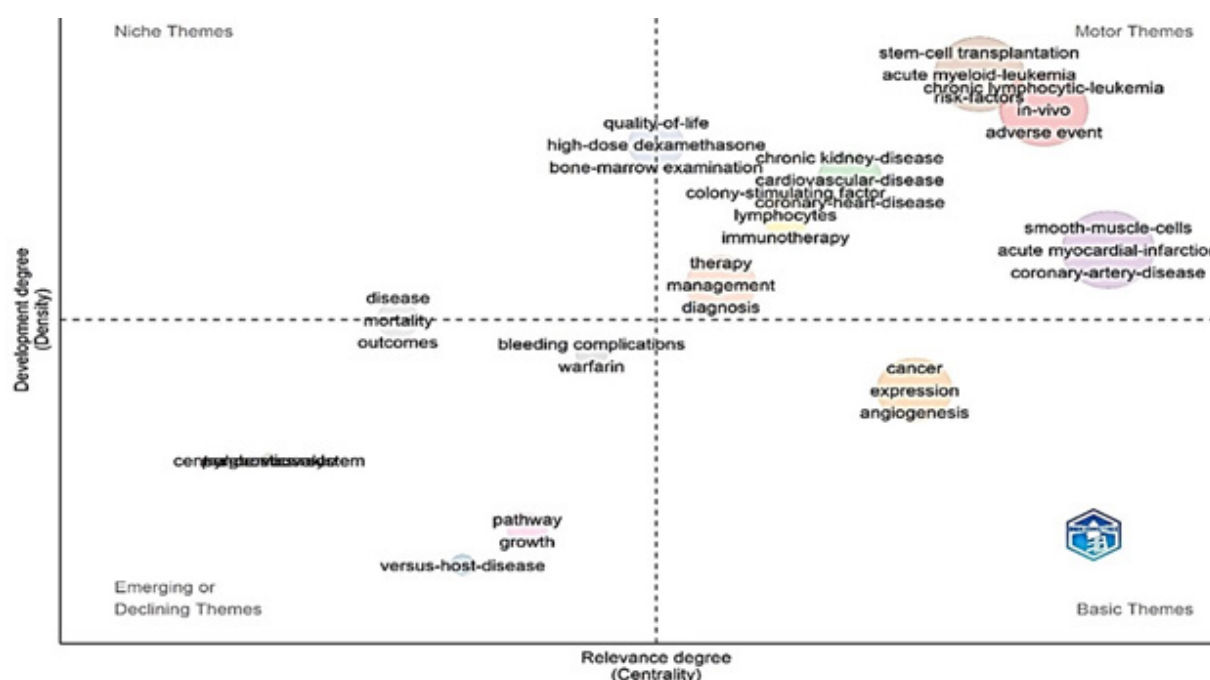


Figure 7. Thematic map of 100 highly-cited hematology articles from 2010-2020

As shown in Figure 7, stem cells, cardiovascular diseases, and leukemia were among the leading topics the researchers paid special attention to in these articles. The basic topics of these articles were also related to cancer, expression, and angiogenesis.

Discussion

This study identified the top 100 highly-cited reviews and original papers in hematology between 2010 and 2020 and analyzed their bibliometric details (e.g., authors, journals, nations, and affiliations, and the like). A publication entitled “Investigation of the freely available easy-to-use software 'EZR' for medical statistics”, written by Kanda Yin in 2013, was the paper with the highest ranking and received 9,886 citations. The citations ranged from a minimum of 708 to a maximum of 9,886, which was close to the citation range in the field of diabetes (15), where papers received from 1121 to 10292 citations, but far more superior to that of the field of orthopedic surgery (range of 353 to 1435) (3).

Notably, a strong correlation emerges between highly cited hematology papers and topics related to peripheral vascular disease and the cardiac and cardiovascular systems. This relationship suggests

that advancements in hematology are increasingly intertwined with cardiovascular health, reflecting the complex interplay between these fields; scientific advances in hematology and cardiology can directly affect each other. Unquestionably, with the progress of one, the other also reaches better knowledge. Various diseases between these two disciplines are of great importance, such as coronary heart disease (16).

Journals such as “Blood,” “Circulation Research,” and “Journal of Thrombosis and Haemostasis” are known for high-quality publications and original research. This quality makes their articles cited as reliable sources in another research. Research topics published in these journals may be critical and interesting at the time, which also helps to increase citations. Journals with higher quartile rankings usually attract more attention from researchers (17). This causes the articles published in these journals to be cited more (18).

The results reveal significant international cooperation in hematology research, with 47% of the top 100 highly-cited articles having co-authors. The amount of cooperation highlights how international scientific inquiry is fostering diverse perspectives and

expertise that improve the quality of research (19). Moreover, the collaboration of multiple institutions in generating these highly cited papers demonstrates a broad dedication to hematological research. This concentration of output at prestigious institutions may influence research trends and funding priorities, suggesting a need for continued support of diverse research environments to ensure a rich and varied scientific landscape in hematology (20).

The present Study indicates that most of the top 100 highly-cited papers in hematology, COVID-19 Related Hematology and Oncology Research (21), and tuberculosis (22) predominantly originate from developed countries, particularly the USA, Germany, and the UK. Considering that the USA, UK, and a small number of countries are leading and continuous producers of science, specifically in medicine, as expected, in hematology, these countries had a higher share in the production of science (23-24). This pattern aligns with previous bibliometric analyses in health care sciences and services (25), showing that countries with robust research infrastructures and financing have a greater concentration of research production and citation impact.

Considering an all-inclusive view and according to the thematic map analysis, the most exciting research themes emerging by the analysis of 100 highly-cited hematology journals included stem cell transplantation, hematologic neoplasms (acute and chronic leukemias), and concepts related to the management of these patients and treatment-related complications (e.g., bone marrow examination, growth factors used to mitigate chemotherapy-associated cytotoxicities such as colony-stimulating factors, and other complications such as renal and cardiac failure), followed by themes such as quality of life, molecular pathogenesis of hematologic cancers, angiogenesis, coagulopathies, and graft-versus-host disease. Although it may not be applicable to draw an overall conclusion on the topics under the focus of hematologists globally based on only 100 highly-cited articles, the topics covered by these papers can be considered hot topics in the field. One can argue that, however, future research in the field can move toward new emerging treatments such as gene therapy, CAR-T cell therapy, and targeted therapy (26-

27). Notably, many current efforts are directed toward managing the complications associated with cytotoxic chemotherapy or bone marrow myeloablative regimens. Undeniably, these adverse effects are responsible for a noteworthy ratio of mortalities due to hematologic neoplasms (28-29). Therefore, it is expected that hematologists should focus more on these new therapeutic technologies in the future.

Conclusion

The most frequently cited reviews and original articles in hematology were analyzed. Analysis of the journals, countries, universities, and authors who have participated the most in publishing highly-cited hematology articles sheds light on the field's most important recent research interests and enables predicting future trends. As it became clear that various topics in the field of hematology have attracted the attention of many researchers worldwide, identifying these articles helps advance the research trajectory in this field. Notably, this research has no specific limitations.

Declaration

Acknowledgment

Not applicable

Conflicts of Interests

The authors declare that they have no conflict of interest.

Ethical Statement

This article is the result of independent research and the authors have observed all ethical issues in all stages of research and publication.

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Authors' contributions

AS and AH designed the study. AH, MHKN, and SM analyzed and interpreted the data. AH, MHKN, and SM drafted the manuscript. AS, RMK, and AB revised the manuscript. All authors read and approved the final manuscript.



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