



# Bibliometric analysis of chronic venous insufficiency publications in web of science database

## Web of science veri tabanında kronik venöz yetmezlik yayınlarının bibliyometrik analizi

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### ABSTRACT

**Aim:** Chronic venous insufficiency (CVI) is a common venous disorder characterized by venous reflux and/or obstruction in the lower extremities and is associated with reduced quality of life. This study aimed to reveal the general research profile of the field by analyzing the scientific publications on chronic venous insufficiency indexed in the Web of Science database using a bibliometric method. **Methods:** The data of the study were obtained by searching the Web of Science database with the keywords "chronic venous insufficiency" or "chronic venous disease" on April 1, 2025. A total of 4855 publications were included in the analysis. The data were analyzed with VOSviewer (version 1.6.19) software, and co-authorship collaboration, publication trends, citation patterns, keywords and country-institution performances were evaluated. **Results:** There has been a marked increase in the number of publications on chronic venous insufficiency in recent years, peaking in 2024 (n=290). The most prolific researchers were Davies AH, Raju S and Gianesini S. The United States of America was identified as the leading country in terms of both the number of publications (n=1104) and citations (n=36,763). The journal that published the most articles was Phlebology (n=507) and the most cited journal was Journal of Vascular Surgery (16,202 citations). Keyword analysis revealed that the most frequently used terms were "chronic venous insufficiency", "varicose veins" and "quality of life". **Conclusions:** Scientific output on chronic venous insufficiency is increasing, with most studies concentrated in the USA and Europe. Key clinical focuses include disease characterization and quality of life. This study offers insight into the current literature structure and future research directions.

### ÖZ

**Amaç:** Kronik venöz yetmezlik (KVY), alt ekstremitelerinde venöz reflü ve/veya obstrüksiyon ile karakterize, yaşam kalitesinde azalma ile ilişkili yaygın bir venöz hastalıktır. Bibliyometrik analizler, bilimsel yayınların niceliksel ve niteliksel özelliklerini ortaya koyarak, araştırma eğilimlerini ve alandaki bilgi boşluklarını belirlemek açısından önem taşır. Bu çalışma, kronik venöz yetmezlik konusunda Web of Science veri tabanında indekslenen bilimsel yayınları bibliyometrik yöntemle inceleyerek, alanın genel araştırma profilini ortaya koymayı amaçlamıştır. **Gereç ve Yöntem:** Çalışmanın verileri, 1 Nisan 2025 tarihinde Web of Science veri tabanında "chronic venous insufficiency" veya "chronic venous disease" anahtar kelimeleriyle yapılan tarama sonucu elde edilmiştir. Toplam 4855 yayın (4204 makale ve 651 derleme makale) analiz kapsamına alınmıştır. Verilerin analizi VOSviewer (1.6.19 sürümü) yazılımıyla yapılmış olup, yazarlar arası iş birliği, yayın eğilimleri, atıf desenleri, anahtar kelimeler ve ülke-kurum performansları değerlendirilmiştir. **Bulgular:** Son yıllarda kronik venöz yetmezlik üzerine yayın sayısında belirgin bir artış gözlenmiş olup, 2024 yılında en yüksek seviyeye ulaşılmıştır (n=290). Araştırmacılar arasında en üretken isimler Davies AH, Raju S ve Gianesini S olarak öne çıkmıştır. Amerika Birleşik Devletleri hem yayın sayısı (n=1104) hem de atıf sayısı (n=36.763) açısından en önde gelen ülke olarak belirlenmiştir. Dergi bazında en fazla makale yayınlayan dergi Phlebology (n=507), en çok atıf alan dergi ise Journal of Vascular Surgery (16.202 atıf) olarak bulunmuştur. Anahtar kelime analizinde en sık kullanılan terimlerin "chronic venous insufficiency", "varicose veins" ve "quality of life" olduğu belirlenmiştir. **Sonuç:** Kronik venöz yetmezlik üzerine yapılan bilimsel çalışmalar giderek artmaktadır ve bu çalışmaların çoğu ABD ve Avrupa'da yoğunlaşmıştır. Temel klinik odak noktaları arasında hastalığın karakterizasyonu ve yaşam kalitesi yer almaktadır. Bu çalışma, mevcut literatür yapısı ve gelecekteki araştırma yönleri hakkında bilgi sunmaktadır.

### Key Words:

Chronic Venous Insufficiency, Chronic Venous Diseases, Bibliometric Analysis, VOSviewer

### Anahtar Kelimeler:

Chronic Venous Insufficiency, Chronic Venous Diseases, Bibliometric Analysis, VOSviewer, Bibliyometrik Analiz

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## **INTRODUCTION**

Chronic venous insufficiency (CVI) is a venous disorder characterized by venous hypertension resulting from venous valve incompetence and/or venous obstruction in the lower extremities, and is associated with clinical manifestations such as leg pain, skin changes, fatigue, edema, cramps, and restlessness. The prevalence of CVI, which is reported to be higher in developed countries, varies between 5% and 30% (Gulati, 2008; Bergan et al., 2006; Robertson et al., 2008; Patel et al., 2024). Advancing age, weight gain, pregnancy, malnutrition, prolonged standing, tight clothing preferences and female gender are risk factors for CVI (Bergan & Pascarella 2007; Jawien, 2003; Beebe-Dimmer et al., 2005).

Chronic venous disease (CVD) refers to the full spectrum of venous disorders affecting the lower extremities, ranging from telangiectasias and varicose veins to skin changes and venous ulcers. CVI represents the more advanced clinical stages of CVD (Ortega et al., 2021).

Chronic venous disease can be classified using the CEAP (C0–C6) classification developed in 1994 and is a common disease affecting millions of people worldwide. According to the clinical classification (CEAP), individuals with mild findings (C1: spider veins) constitute 26% of the adult population and those with varicose veins (C2) constitute 19%. Active venous ulcer (C6), the most advanced stage, is seen in ~0.4% of the general population (Salim et al., 2021). According to recent clinical guidelines, chronic venous insufficiency (CVI) is defined as CEAP clinical classes C3–C6 (Gloviczki, 2024).

Bibliometric analysis, which was first used in 1969, is a method that enables the numerical analysis of academic publications published on a specific subject. It provides the opportunity to reveal the prominent researchers in a research field, frequently preferred keywords, influential journals, countries and institutions where research is concentrated, and the most cited sources with quantitative data (Wu et al., 2022). In this respect, bibliometric analysis allows evaluation of the scope and structure of scientific studies, while also allowing guiding inferences to be made about future research. Visualization software such as VOSviewer is used to present analysis results in a more understandable and accessible way (Xiong et al., 2023). Such tools enable the visualization and interpretation of bibliometric data. When the literature is examined, it is seen that studies evaluating research productivity related to studies on chronic venous insufficiency are quite limited. The main aim of this study was to evaluate the research productivity in this field with the help of VOSviewer software (version 1.6.19) by examining the publications on chronic venous insufficiency published in journals in the Web of Science database by bibliometric analysis method.

## **MATERIAL AND METHODS**

The research data were obtained from the Web of Science (WOS) Core Collection database. The Web of Science Core Collection was used as the data source for this bibliometric analysis. To obtain the research data, a literature search was conducted on April 1, 2025, following the workflow presented in Figure 1. The search was performed in the Web of Science Core Collection database using the “topic” filter, which includes title, abstract, author keywords, and Keywords Plus. The following search formula was applied:

TS = (“chronic venous insufficiency” OR “chronic venous disease”).

The search was limited to English-language publications indexed in the Web of Science Core Collection. Only articles and review articles were included in the analysis. The keywords included in the search formula were determined based on prior literature screening and relevant studies in the field of chronic venous insufficiency.

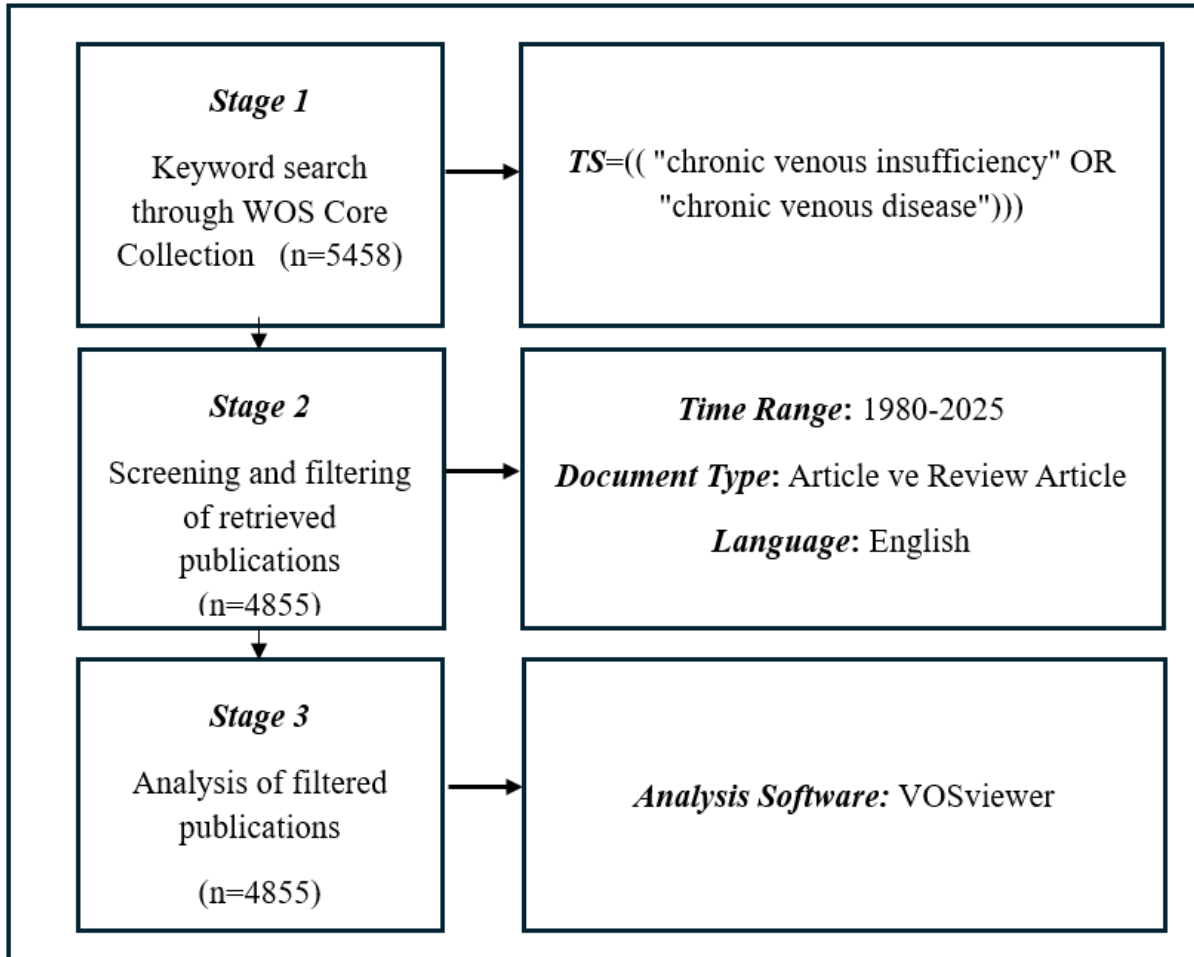


Figure 1. Research Flowchart

Among these records, only “article” and “review article” type publications were filtered and the data set was reduced to 4855. The obtained data were downloaded as 5 .txt format files, each containing 1000 records, using the “Export - Tab Delimited” and “Custom Selection” options of the relevant database.

The data were analyzed with the bibliometric analysis tool VOSviewer (version 1.6.19). VOSviewer is a software developed by Van Eck and Waltman in 2010 and based on the “Visualization of Similarities” methodology. The program, which is widely used in bibliometric analysis of scientific publications, allows determination of the most effective publications that are cited, revealing the collaboration networks between researchers and visualizing the structural features of multi author studies (Van et al., 2010). Within the scope of the analysis, a total of 4204 articles and 651 review articles from different disciplines were evaluated, with the oldest 1980 and the newest 2025. The data obtained were analyzed in detail at the level of author, citation, journal, country, institution, keywords and abstracts.

This study was designed as an exploratory bibliometric analysis aimed at identifying overall research trends in the field. Therefore, no predefined hypotheses or hypothesis-testing statistical analyses were formulated.

### Bibliometric Analysis of Publication

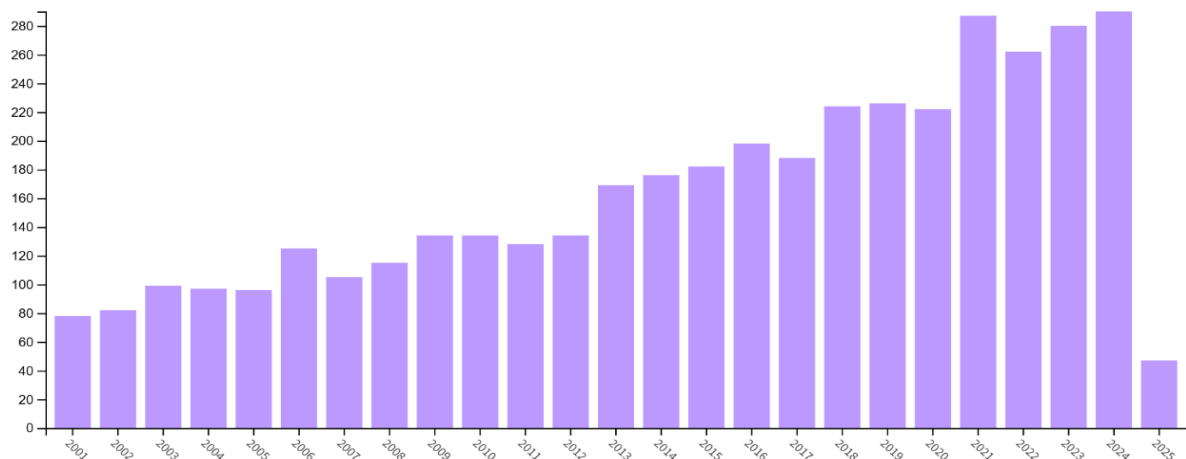
Output As of April 2025, the number of publications obtained by searching the Web of Science database using the keywords “chronic venous insufficiency” OR “chronic venous disease” are presented in Table 1 according to years. Since 2006, it is seen that the annual number of publications has exceeded 100, and more than 280 publications were made in 2021 and 2024. The highest number of publications was realized in 2024.

**Table 1.** Number and Years of Publications on Chronic Venous Insufficiency

Year	NoP	Year	NoP	Year	NoP	Year	NoP	Year	NoP
2025	47	2015	182	2005	96	1995	38	1985	9
2024	290	2014	176	2004	97	1994	64	1984	16
2023	280	2013	169	2003	99	1993	49	1983	7
2022	262	2012	134	2002	82	1992	40	1982	14
2021	287	2011	128	2001	78	1991	39	1981	5
2020	222	2010	134	2000	95	1990	20	1980	17
2019	226	2009	134	1999	84	1989	10		
2018	224	2008	115	1998	62	1988	14		
2017	188	2007	105	1997	81	1987	17		
2016	198	2006	125	1996	78	1986	18		

#### NoP: Number of Publications

The distribution of publications indexed in the Web of Science database between 2001 and 2025 is shown in Figure 2. Although Table 1 includes data from 1980 onward, Figure 2 focuses on the period starting from 2001 in order to better highlight the increase in research output in recent years.



**Figure 2.** Distribution of Publications on Chronic Venous Insufficiency by Years

### Co-Author Network Analysis

Co-Author Network Analysis In the co-author network analysis, the collaborative relationships between researchers working in the field of chronic venous insufficiency were visualized. When Figure 3 is examined, it is seen that Davies, who is at the center of the network, has a comprehensive and strong collaboration network on chronic venous insufficiency. The analysis showed that various sub-research groups have been formed through connections extending in different directions from this central network formed by Davies. Other researchers such as Raju and Giancesini also occupy important positions within the network structure. It is understood that these authors produce joint publications with other researchers around them and make significant contributions to scientific production in the field of chronic venous insufficiency. The colors of the nodes represent different collaboration clusters identified by VOSviewer; authors shown in the same color have stronger and more frequent collaborative relationships.

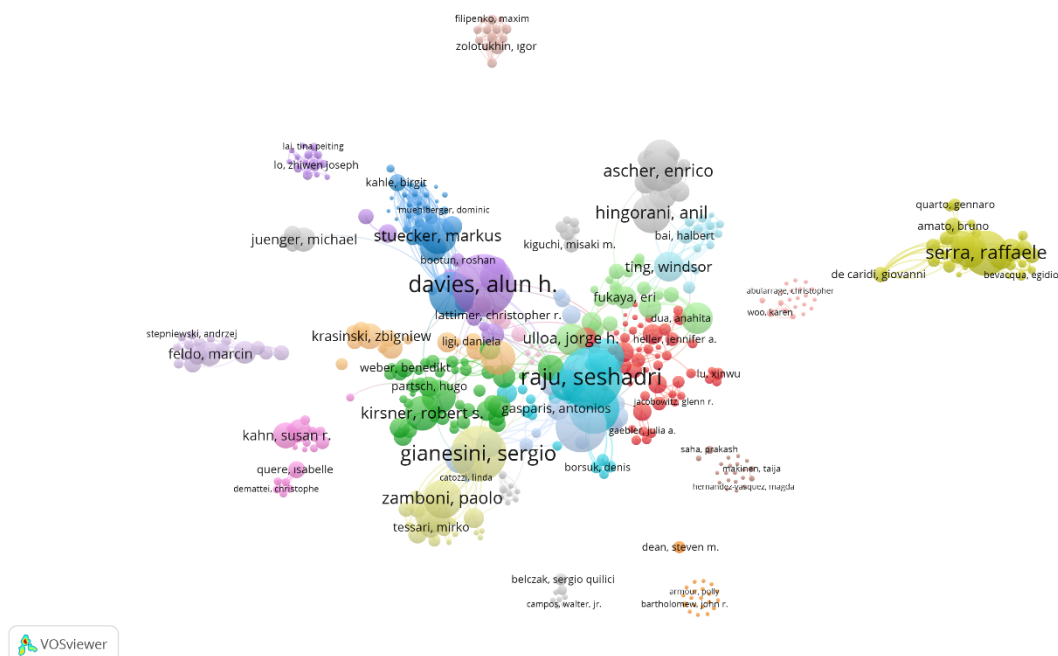


Figure 3. Co-author distribution

The researchers with the most publications in the field of chronic venous insufficiency are ranked according to the number of articles (Table 2). The researcher with the highest number of publications in this field is Davies AH with 48 articles. Davies is followed by Raju S with 47 articles and Giancesini S with 43 articles. The authors of the 10 most cited studies on chronic venous insufficiency are listed in Table 3. Chiu (2011) ranks first with 1637 citations and it is understood that this study has become an important reference source in the literature. These data contribute to the identification of researchers and studies that shape the field in terms of both scientific productivity and citation impact.

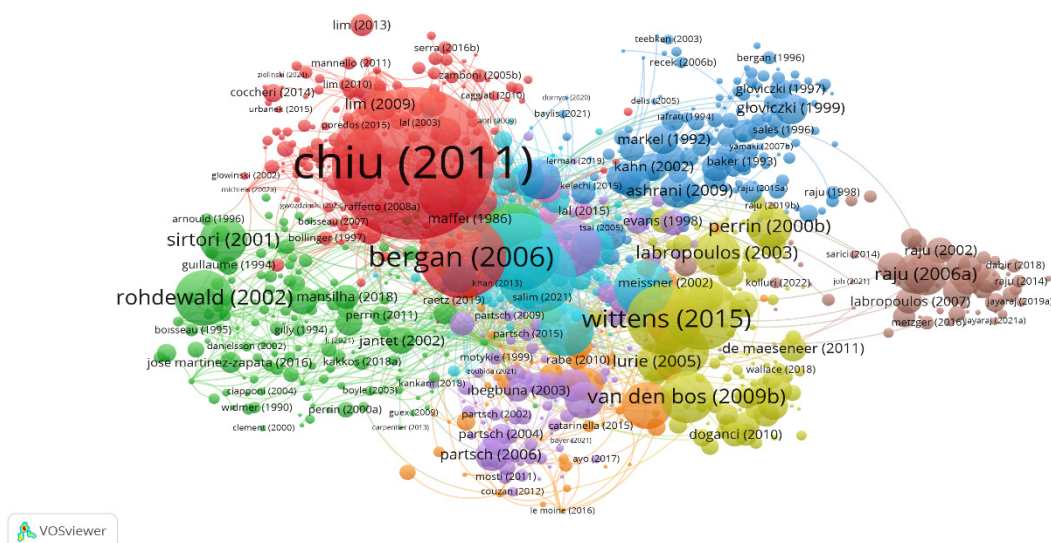
**Table 2.** Top 10 with the Most Publications on Chronic Venous Insufficiency

Queue	Authors with the Most Publications	Number of Articles
1	Davies AH	48
2	Raju S	47
3	Gianesini S	43
4	Lurie F	39
5	Labropoulos N	38
6	Belcaro G	33
7	Garcia H	32
8	Bujan J	31
9	Rabe E	31
10	Serra R	30

**Table 3.** Authors of the Top 10 Most Cited Articles on Chronic Venous Insufficiency

Queue	Authors of the 10 most cited studies	Number of Citations
1	Chiu (2011)	1637
2	Bergan (2006)	708
3	Beebe-Dimmer (2005)	656
4	Evans (1999)	612
5	Wittens (2015)	584
6	Rutherford (2000)	583
7	Eberhardt (2014)	440
8	Rohdewald (2002)	423
9	Lurie (2020)	417
10	Nicolaides (2000)	414

Figure 4 illustrates the distribution of the top 10 most cited studies on chronic venous insufficiency. The size of the nodes represents the citation impact of each article, while the colors indicate different clusters of related publications. Links between nodes reflect co-citation relationships, showing how frequently these influential articles are cited together in the literature.



**Figure 4.** Distribution of the top 10 cited studies



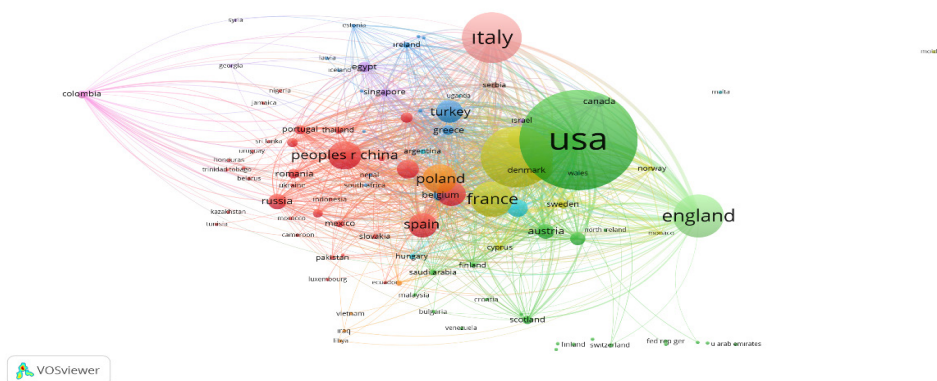
### Bibliometric Analysis of Publishing Countries

Table 5 shows the leading countries in terms of the number of publications and citations in the field of chronic venous insufficiency. The United States of America (USA) ranks first by far in terms of both publication production and number of citations (1104 publications and 36,763 citations). European countries such as Germany (n=569), Italy (n=441) and the UK (n=356) stand out in terms of the number of publications, while the UK (n=12,442) and Germany (n=11,380) are at the top in terms of the number of citations. According to the number of publications, Turkey ranks 11th with 151 articles.

**Table 5.:** Analysis of the Top 10 Countries Producing the Most Publications and Receiving the Most Citations on Chronic Venous Insufficiency

Sequencing	Country	Number of Publications	Country	Number of Citations	Sequencing
1	USA	1,104	1	USA	36,763
2	Germany	569	2	England	12,442
3	Italy	441	3	Germany	12,308
4	England	356	4	Italy	9,572
5	France	270	5	France	8,189
6	Poland	211	6	Netherlands	5,565
7	China	201	7	Spain	4,345
8	Brazil	169	8	Poland	3,389
9	Spain	168	9	Switzerland	3,188
10	Netherlands	160	10	Scotland	2,817
11	Turkey	151	11	Austria	2,721

Figure 6 presents an analysis of the scientific collaboration network in the field of chronic venous insufficiency. It can be seen that countries such as the United States, Germany, the United Kingdom and Italy are positioned as prominent nodes at the center of the network. The United States, in particular, has assumed a pioneering role in the chronic venous insufficiency literature thanks to its strong and intensive collaboration networks with many countries. Other centrally located countries also make significant contributions to scientific production in the field through their international collaborations. When the color distribution of the network by years is examined, the analysis showed that the green and yellow tones intensified after 2010. This situation reveals that the number of publications in the field of chronic venous insufficiency has increased in recent years and that research activities have gained momentum (Figure 7).



**Figure 6.** Network visualization of inter-country collaboration in the field of chronic venous insufficiency

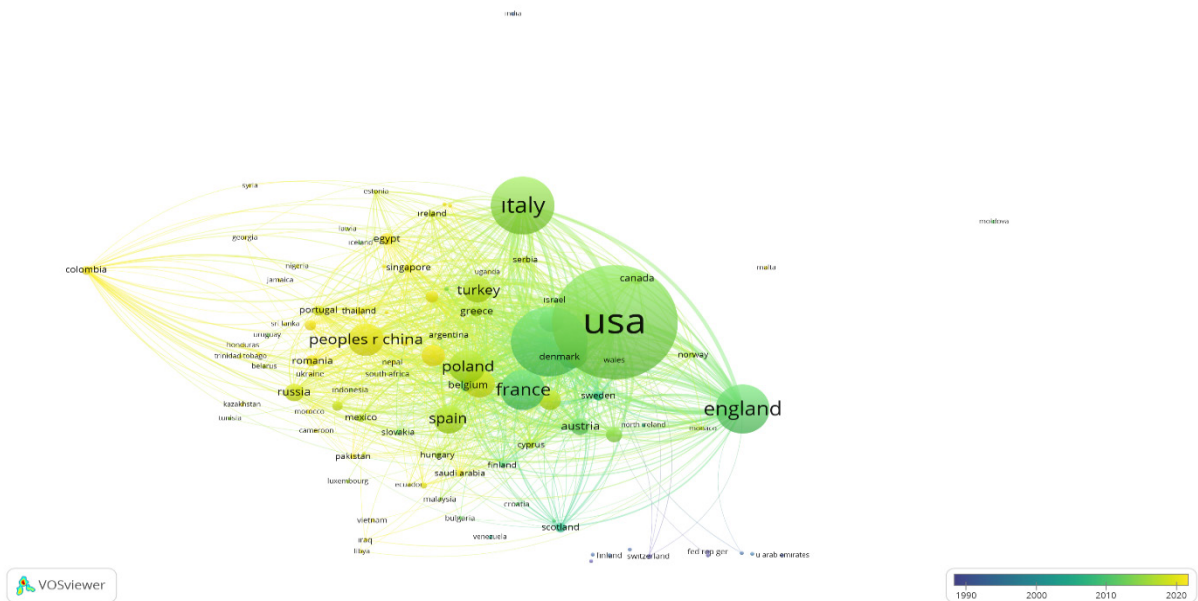


Figure 7. Overlay visualization based on average publication year

### Journal Publication and Citation Analysis

The top 10 journals with the highest number of articles and the highest number of citations in the field of chronic venous insufficiency are shown in Table 6. The top five journals in terms of number of publications are Phlebology (507 articles), Journal of Vascular Surgery-Venous and Lymphatic Disorders (288 articles), Journal of Vascular Surgery (239 articles), International Angiology (167 articles) and European Journal of Vascular and Endovascular Surgery (160 articles). The most cited journals according to the number of citations are as follows: Journal of Vascular Surgery (16,202 citations), European Journal of Vascular and Endovascular Surgery (7,431 citations), Phlebology (7,023 citations), Journal of Vascular Surgery-Venous and Lymphatic Disorders (3,817 citations) and Angiology (3,006 citations). The differences between the number of articles and the number of citations are directly related to the impact factors of journals, their target audiences and the frequency of scientific use of their publications. This shows that the visibility of a journal in the scientific field should be evaluated not only by the number of articles it publishes, but also by the number of citations it receives.

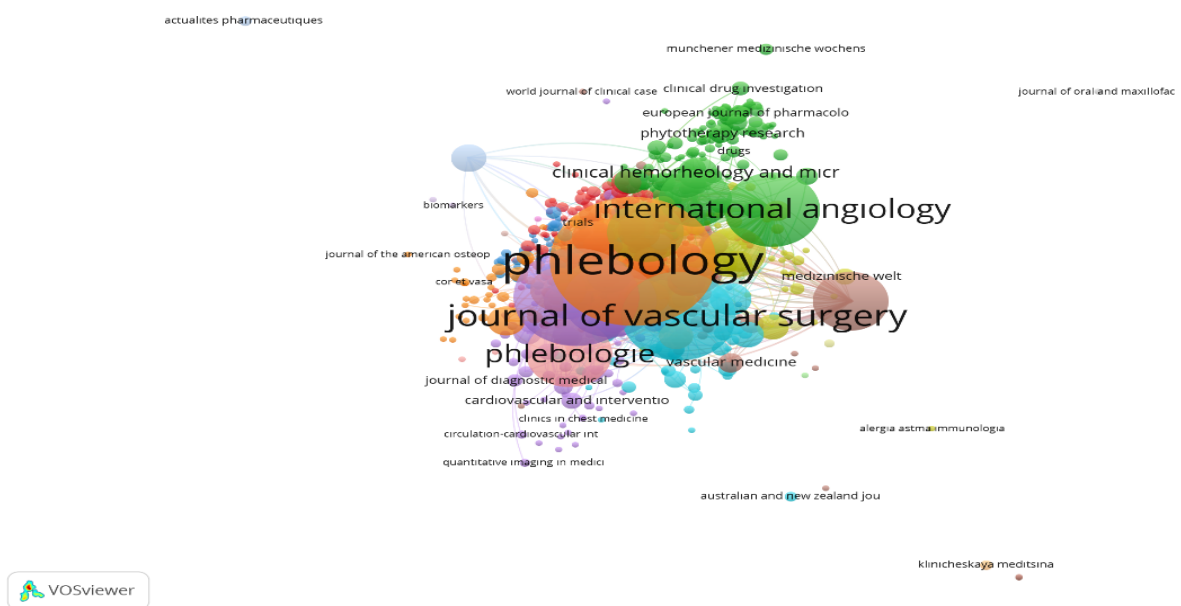
Table 6.: Top 10 Journals with the Most Articles and Highest Citation Rate in the Field of Chronic Venous Insufficiency

Sequencing	Top 10 Magazines by Issue	Number of Publications	Sequencing	Top 10 Journals by Number of Citations	Number of Citations
1	Phlebology	507	1	Journal of Vascular Surgery	16,202
2	Journal of Vascular Surgery-Venous and Lymphatic Disorders	288	2	European Journal of Vascular and Endovascular Surgery	7,431
3	Journal of Vascular Surgery	239	3	Phlebology	7,023

**Table 6 (Continue).** Top 10 Journals with the Most Articles and Highest Citation Rate in the Field of Chronic Venous Insufficiency

Sequencing	Top 10 Magazines by Issue	Number of Publications	Sequencing	Top 10 Journals by Number of Citations	Number of Citations
4	International Angiology	167	4	Journal of Vascular Surgery-Venous and Lymphatic Disorders	3,817
5	European Journal of Vascular and Endovascular Surgery	160	5	Angiology	3,006
6	Phlebologie	138	6	International Angiology	2,905
7	Phlebolympology	110	7	Annals of Vascular Surgery	1,928
8	Annals of vascular surgery	107	8	Physiological Reviews	1,637
9	Angiology	98	9	Journal of the American Academy of Dermatology	1,536
10	Vasa-journal of Vascular Diseases	77	10	Circulation	1,376

Figures 8 and 9 present a bibliometric network analysis of journals publishing on chronic venous insufficiency. Figure 8 shows the co-citation network, where node size indicates publication volume and links reflect citation strength. Figure 9 visualizes the temporal distribution of journal activity, where node color corresponds to average publication year, highlighting increased recent interest in the topic.

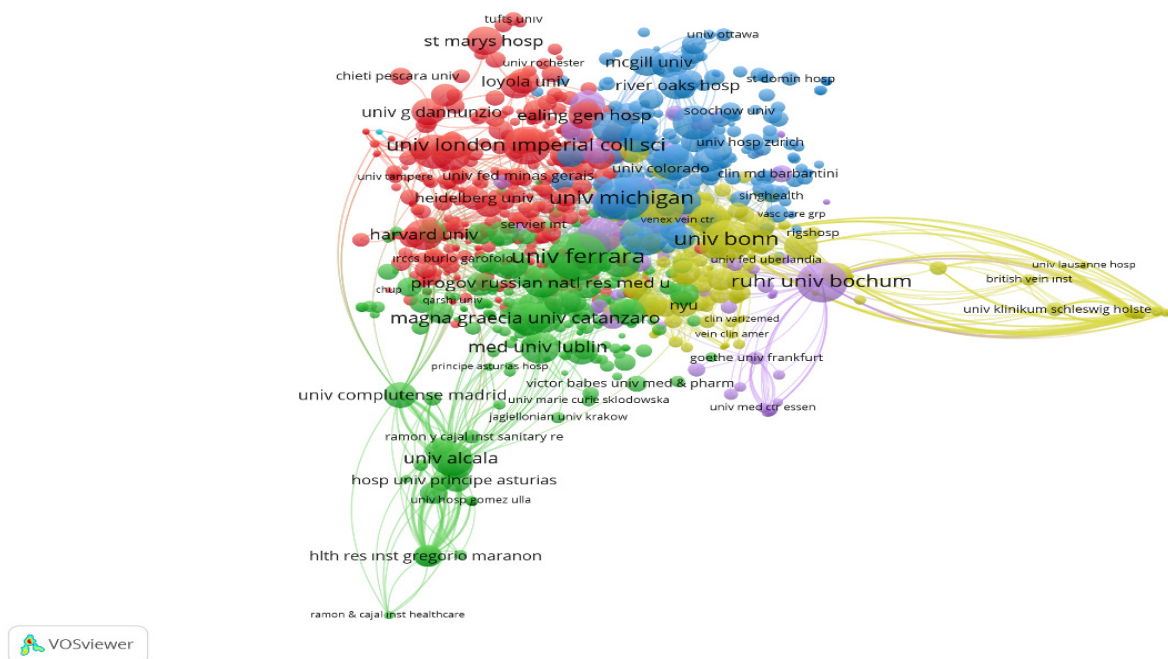


**Figure 8.** Bibliometric Network – Co-Citation of Journals



**Table 7 (Continue).** Top 10 Institutions with the Most Publications and Highest Citation Rate

Sequencing	Top 10 Institutions by Number	Number of Publications	Sequencing	Top 10 Institutions by Number of Citations	Number of Citations
5	Imperial College London	44	5	River Oaks Hospital	2,065
6	London Imperial College Science, Technology ve Medicine	42	6	Michigan University	1,922
7	Erasmus University Medical Center	41	7	Erasmus University Medical Center	1,878
8	Miami University	38	8	Harvard University	1,864
9	Masstricht University	37	9	Carolina University	1,830
10	California San Diego University	35	10	London Imperial College Science, Technology ve Medicine	1,767



**Figure 10.:** Bibliometric Network Analysis Of Publications By Institutions

The cooperation between research institutions in the field of chronic venous insufficiency is illustrated in Figure 10. This map visualizes the cooperation between research institutions based on co-authorship data. Each node represents an institution that has published on chronic venous insufficiency. The size of the nodes reflects the total number of publications affiliated with each institution. The links between nodes indicate co-authorship ties, where thicker lines represent stronger collaboration (i.e., higher number of co-authored papers). Colors denote clusters of institutions that are more interconnected, often indicating regional or thematic research partnerships.

## **Limitations**

In this study, chronic venous insufficiency literature was analyzed only with the data obtained from the Web of Science Core Collection (WoSCC) database. Since publications in other important scientific databases such as PubMed and Scopus were excluded from this analysis, it is recommended to include other databases for a more comprehensive bibliometric evaluation. In addition, the search terms and strategies used in the study are based on a specific approach, and searches with different keyword combinations may reveal other dimensions of the issue. In addition journal-level self-citation rates were not separately analyzed, which represents another limitation of this study. Since the publications included in the study consisted of indexed articles, some studies that have not yet been indexed or recently published may have been excluded from the analysis. This may affect the timeliness of the findings to a limited extent. Finally, although the VOSviewer software used in bibliometric mapping and analysis is an effective tool, the use of alternative software such as CiteSpace and Bibliometrix may enable a more comprehensive evaluation of the literature from different perspectives.

## **DISCUSSION**

This bibliometric analysis has revealed a marked increase in publication output in the field of chronic venous insufficiency (CVI) in recent years. In particular, 2024 stands out as the year with the highest number of publications to date. This trend is consistent with previous studies reporting that research activity in the field of chronic venous diseases has increased in parallel with clinical and technological advancements (Jun & Hwang, 2020).

From a geographical perspective, CVI research is predominantly concentrated in the United States, followed by European countries such as Germany and Italy. Turkey's ranking as 11th in terms of publication output indicates that it holds a regionally significant position in this field. One of the primary factors underlying this geographical concentration may be the global distribution of research funding. The National Institutes of Health (NIH) had an approximate research budget of USD 47.4 billion in 2024 (Klotz, 2025). Similarly, under the European Union's Horizon Europe program, a total budget of EUR 93.5 billion was allocated for research and innovation during the 2021–2027 period (European Commission, 2020). In addition, the high concentration of advanced clinical research centers and academic health institutions in the United States and European countries is noteworthy. According to the Nature Index health sciences rankings, the vast majority of institutions with the highest scientific output in medicine and health worldwide are located in the United States and Western Europe (Nature Index, 2024). Moreover, large hospitals and academic medical centers in the United States and Europe serve as leading institutions where innovative treatments are implemented and clinical research is conducted. Large tertiary referral centers in North America and Europe account for approximately 42% of hospital-based vascular surgery procedures worldwide (Market Growth Reports, 2025).

High patient volumes, relatively easy access to clinical data, and the presence of strong multicenter collaboration networks in these centers may contribute to increased research productivity in chronic and prevalent conditions such as chronic venous insufficiency. Keyword analysis revealed that the literature primarily focuses on disease definitions, quality-of-life outcomes, and treatment-related concepts—particularly conservative approaches such as compression therapy. Although sclerotherapy appeared among frequently used keywords, it is technically a minimally invasive rather than conservative procedure. Despite the central role of endovenous ablation and venous surgery in the contemporary management of chronic venous

insufficiency (CVI), these terms were underrepresented in the keyword analysis. This finding may be attributed to the topic-based search strategy, as interventional studies are often indexed under procedure-specific terminology (e.g., ‘endovenous laser ablation’, ‘radiofrequency ablation’, or ‘varicose vein surgery’) without explicitly using the terms ‘chronic venous insufficiency’ or ‘chronic venous disease’ as primary keywords.

The keyword analysis suggests that chronic venous insufficiency (CVI) is not only approached as a pathophysiological condition, but also increasingly recognized as a chronic disease with a significant impact on patients’ daily lives. This interpretation is supported by the frequent co-occurrence of terms such as “quality of life,” “compression therapy,” and “daily life,” reflecting a broader, patient-centered perspective in the literature.

Journal analysis identified Phlebology and the Journal of Vascular Surgery as the main publication outlets for CVI research. The high citation rates of these journals indicate that the studies published therein have substantial influence on the literature and contribute significantly to the advancement of the field.

The analysis also revealed a clear discrepancy between the most productive authors and the most highly cited publications in the field of CVI. This finding reflects the well-recognized distinction between publication volume and scientific impact. Highly cited articles are often landmark studies, clinical guidelines, consensus documents, or population-based epidemiological studies that accumulate citations over time, whereas highly productive authors may publish a greater number of original or clinically focused studies with more limited citation reach. Therefore, citation counts should be interpreted as indicators of scientific influence rather than productivity.

Although citation count is a widely used bibliometric indicator, it does not directly reflect methodological quality or clinical relevance. Citation rates may be influenced by factors such as publication age, journal visibility, preference for review articles, and self-citation practices. Accordingly, citation-based metrics should be interpreted with caution and in conjunction with other qualitative indicators. All records included in this study were retrieved from the Web of Science Core Collection and filtered by document type and language to minimize the risk of duplicate publications. However, citation clustering around seminal works may create the appearance of repetition, particularly in guideline-driven research fields such as CVI.

## **CONCLUSION**

In conclusion, this bibliometric analysis provides a comprehensive overview of research trends, leading countries, institutions, journals, and thematic priorities in the field of chronic venous insufficiency. The findings demonstrate that CVI research is predominantly concentrated in high-income countries, a pattern closely associated with disparities in research funding, clinical infrastructure, and academic collaboration networks. Moreover, the observed distinction between research productivity and scientific impact offers important insights into the interpretation of bibliometric indicators. These bibliometric findings may contribute to the strategic planning of future CVI research by identifying underrepresented regions, guiding the development of new international collaborations, and supporting a more balanced allocation of research priorities.

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