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A BIBLIOMETRIC OVERVIEW OF ENDOVENOUS LASER ABLATION RESEARCH

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Abstract: In managing saphenous vein reflux, endovenous laser ablation (EVLA) has emerged as a trendy minimally invasive substitute in recent years. The development of this field benefits from a thorough understanding of its state of development, and bibliometric analysis may help this. However, no bibliometric analysis has adequately summed up this field. In this study, we sought to analyze decades' worth of EVLA literature. The present study aimed to retrieve information from journals listed in the Web of Science (WoS) search engine with the dataset "TI= (EVLA) or TI= (Endovenous Laser Ablation)." We searched the WoS core collection. There were 471 publications (70.701% articles). They were cited 8062 times totally and 17.12 times per article. The mean Hirsch (H) index of the published documents was 49. Over the past 20 years, there has been a gradual rise in the number of publications and citations in EVLA research, suggesting that the field has gained attention. The United States of America (USA) (n=99), England (n=48), Netherlands (n=48), Türkiye (n=46), and Germany (n=40) were the top five publishing countries on EVLA research. The findings showed that the number of published documents was limited. The contribution was only from 46 countries. The number of publications and the number of broadcasting countries should be increased.

Keywords: EVLA, Endovenous laser ablation, Bibliometrics

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1. Introduction

About 50% of adults suffer from chronic venous insufficiency, one of the most prevalent vascular system disorders (Chwała et al., 2015). The lower extremities are the most common location for twisted, dilated varicose veins. Although the specific pathogenesis is unclear, it is thought to be a combination of genetic predisposition, ineffective valves, compromised arterial walls, and elevated intravenous pressure (Raetz et al., 2019). Female sex, advanced age, persistently elevated intra-abdominal pressure brought on by obesity, pregnancy, chronic constipation, or a tumor, as well as prolonged standing, are risk factors for venous illness. A heavy, achy feeling, as well as an itchy or burning sensation, are varicose vein symptoms that get worse with extended standing. Leg ulcers, stasis changes, infection, and thrombosis are all possible side effects. External compression, lifestyle changes such as avoiding extended standing and straining, exercising, wearing loose-fitting clothing, modifying cardiovascular risk factors, and measures to minimize peripheral edema are examples of conservative therapy approaches (Chwała et al., 2015; Raetz et al., 2019).

In the management of saphenous vein (SV) reflux, endovenous laser ablation (EVLA) has emerged as a very popular, minimally invasive substitute for surgical vein stripping (Vuylsteke et al., 2012). Carlos Boné published the first study on EVLA in 1999 (Boné, 1999). Before the late 1990s, stripping and high ligation was the gold standard for treating refluxing truncal veins (van den Bremer and Moll, 2010). Great saphenous vein (GSV) ligation was first described in the middle of the 1500s, but it wasn't until Friedrich Trendelenburg published a paper explaining the method in the late 1800s that it became widely used. Other modified and combined surgical techniques developed after American surgeons Mayo, Keller, and Van der Stricht described vein stripping methods in the early 1900s (Boné, 1999). EVLA was approved for the treatment of SV reflux in the United States of America (USA) in 1999, and it has since established itself as a standard method of treating chronic venous insufficiency both domestically and internationally (Boné, 1999).

Therapy for varicose veins should aim to improve the clinical picture, reduce symptoms, and stop the illness from progressing. This is frequently accomplished by removing or treating the source of reflux. The endothermal procedures of EVLA and radiofrequency ablation (RFA) are currently seen as the treatments of choice for symptomatic truncal venous reflux according to the Society of Vascular Surgery and American Venous Forum clinical practice recommendations (Gloviczki et al., 2011). EVLA has been shown to be a reliable, long-lasting therapeutic choice for symptomatic, unsuccessful superficial and perforator veins of the lower limbs.

Recurrence rates and general quality of life are improved with therapy, and EVLA can be conducted in the ambulatory setting with less pain, morbidity, and recovery time (Chwała et al., 2015, Teter et al., 2011; Oğuzkurt, 2012).

The use of EVLA is not widely reported in pediatric cases, but some reports have been published in recent years (Patel et al., 2017; Bittles et al., 2019). In order to provide a quantitative examination of textual publications, bibliometric methodologies have been utilized (Huffman et al., 2013; Küçük et al., 2021). A bibliometric tool called VOSviewer is used to build relationship networks and visualize data. Its ability to analyze vast amounts of data and good graphical skills make it stand out (Perianes-Rodriguez et al., 2016). Bibliometric metrics are now a crucial component of the evaluation of academic production as in modern decade. These criteria (publication count, citation count, h-index, etc.) are used to assess authors and journals. Assessment of academic production, including preparation for promotions and other prizes, can be aided by effective use of existing and developing bibliometric Technologies (Choudhri et al., 2015). In this study, in order to illustrate the knowledge base, evolving patterns, and emerging hotspots of EVLA research, we used the Web of Science Core Collection (WoSCC) database as a data source using VOSviewer and Microsoft Excel.

2. Materials and Methods

2.1. Search Tools

The purpose of this study was to retrieve information from journals listed in the Web of Science (WOS) search engine with the dataset "TI = (EVLA) or TI = (Endovenous Laser Ablation)". We searched the Web of Science core collection "SCI-EXPANDED, SSCIESCI, A&HCI, CPCI-S, CPCI-SSH, BKCIS, BKCI-SSH" indexes.

2.2. Search Strategy

The WOS search engine was used to conduct a search using keywords associated with "EVLA" or "Endovenous Laser Ablation". English words are used for results that are more accurate. The time frame was set between 1970 and 2022. Data on the expansion of publications, the most active nations and institutions, authors, affiliations, and articles that received the most citations were all examined. As a measure of the effect of publications, the Hirsch (H) index was used.

In order to assess the trend of the EVLA study, Excel 2010 and Wos database's graphics were used. No other statistical methods were used. The required network visualization was made with the help of the Windows-compatible VOSviewer program, version 1.6.18.

3. Results

There were 471 publications (70.701% articles, 9.130% proceeding papers, 7.643% meeting abstracts, 6.582% letters, 5.732% editorials, 3.609% review articles, and the rest of them other publications). They were cited 8062 times total and 17.12 times per article. The mean Hirsch (H) index of the published documents was 49. The distribution of publications annually in the last 20 years is shown in Figure 1. The first articles were published in 2002. Over the past 20 years, there has been a gradual rise in the number of publications and citations in EVLA research, showing that the field has gained attention (Figure 1).

46 countries contributed to the EVLA literature. The United States of America (USA) (n = 99), England (n = 48), the Netherlands (n=48), Türkiye (n=46) and Germany (n=40) were the top 5 publishing countries in EVLA research. The summary of publishing countries is given in Table 1.

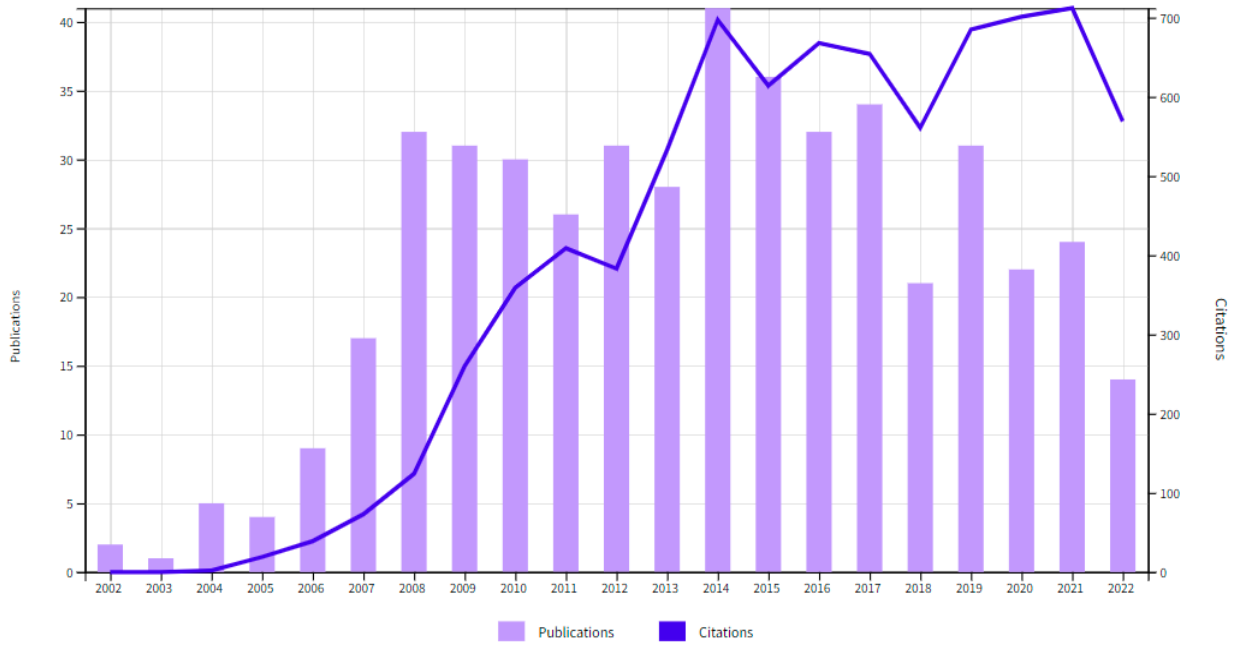

Figure 1. Times cited and publications over time.

Table 1. The mostly publishing countries on EVLA

Ranking	Countries/Regions	Record Count	% of 471
1	The USA	99	21.019
2	England	76	16.136
3	Netherlands	48	10.191
4	Türkiye	46	9.766
5	Germany	40	8.493
6	Peoples Republic of China	16	3.397
7	South Korea	16	3.397
8	Switzerland	12	2.548
9	Belgium	11	2.335
10	Italy	11	2.335

Showing 10 out of 46 entries; 25 record(s) (5.308%) do not contain data in the field being analyzed.

The vast majority of the EVLA publications were from surgery (n=298), cardiovascular system cardiology (n=267), and radiology/nuclear medicine/medical imaging (n=42) (Table 2).

The leading affiliations in EVLA research were mostly from the Netherlands and the United Kingdom (Table 3).

The Phlebology journal was the most published journal on EVLA research. This journal published 55 documents on EVLA (Table 4).

Daniel Carradice from England (n=21) was the leading author on EVLA research (Figure 2).

The most cited publications are summarized in Table 5.

3.1. Mapping

Figure 3, 4 and 5 are showing the citation analysis, co-authorship analysis between top 100 authors and occurance analysis of the mainly preferred keywords.

Table 2. The research areas

Research Areas	Record Count	% of 471
Surgery	298	63.270
Cardiovascular System Cardiology	267	56.688
Radiology/ Nuclear Medicine/ Medical Imaging	42	8.917
Engineering	29	6.157
Dermatology	26	5.520
Astronomy Astrophysics	23	4.883
General Internal Medicine	23	4.883
Optics	12	2.548
Instruments Instrumentation	9	1.911
Research Experimental Medicine	7	1.486

Showing 10 out of 32 entries.

Table 3. The affiliations with more than 10 publications on EVLA

Affiliations	Record Count	% of 471
Erasmus Medical Center, The Netherlands	21	4.459
Erasmus University Rotterdam, The Netherlands	21	4.459
University Of Hull, United Kingdom	20	4.246
National Radio Astronomy Observatory, The USA	18	3.822
Leeds General Infirmary, United Kingdom	17	3.609
University Of York, United Kingdom	14	2.972
Academic Medical Center Amsterdam, The Netherlands	11	2.335
University Of Amsterdam, The Netherlands	11	2.335
University Of Bonn, Germany	9	1.911
University Of Surrey, United Kingdom	9	1.911

Showing 10 out of 570 entries; 27 record(s) (5.732%) do not contain data in the field being analyzed.

Table 4. The list of mostly publishing journals on EVLA

Ranking	Publication Titles	Record Count	% of 471
1	Phlebology	55	11.677
2	European Journal of Vascular and Endovascular Surgery	38	8.068
3	Journal of Vascular Surgery Venous and Lymphatic Disorders	37	7.856
4	Journal of Vascular Surgery	35	7.431
5	British Journal of Surgery	31	6.582
6	Journal of Vascular and Interventional Radiology	17	3.609
7	Lasers in Medical Science	16	3.397
8	Annals of Vascular Surgery	15	3.185
9	Dermatologic Surgery	10	2.123
10	Egyptian Journal of Surgery	9	1.911

Showing 10 out of 141 entries.

Table 5. The summary table of the mosstly cited 5 articles on EVLA

Reference	Publication name	Journal	Number of total citations	Average per year
Rasmussen et al, 2011	Randomized clinical trial comparing endovenous laser ablation, radiofrequency ablation, foam sclerotherapy and surgical stripping for great saphenous varicose veins	The British journal of surgery	389	32.42
Darwood et al, 2008	Randomized clinical trial comparing endovenous laser ablation with surgery for the treatment of primary great saphenous varicose veins.	The British journal of surgery	217	14.47
Puggioni et al, 2005	Endovenous laser therapy and radiofrequency ablation of the great saphenous vein: analysis of early efficacy and complications.	Journal of vascular surgery	205	11.39
Rasmussen et al, 2007	Randomized trial comparing endovenous laser ablation of the great saphenous vein with high ligation and stripping in patients with varicose veins: short-term results.	Journal of vascular surgery	195	12.19
Almeida et al, 2009	Radiofrequency endovenous ClosureFAST versus laser ablation for the treatment of great saphenous reflux: a multicenter, single-blinded, randomized study (RECOVERY study).	Journal of vascular and interventional radiology	178	12.71

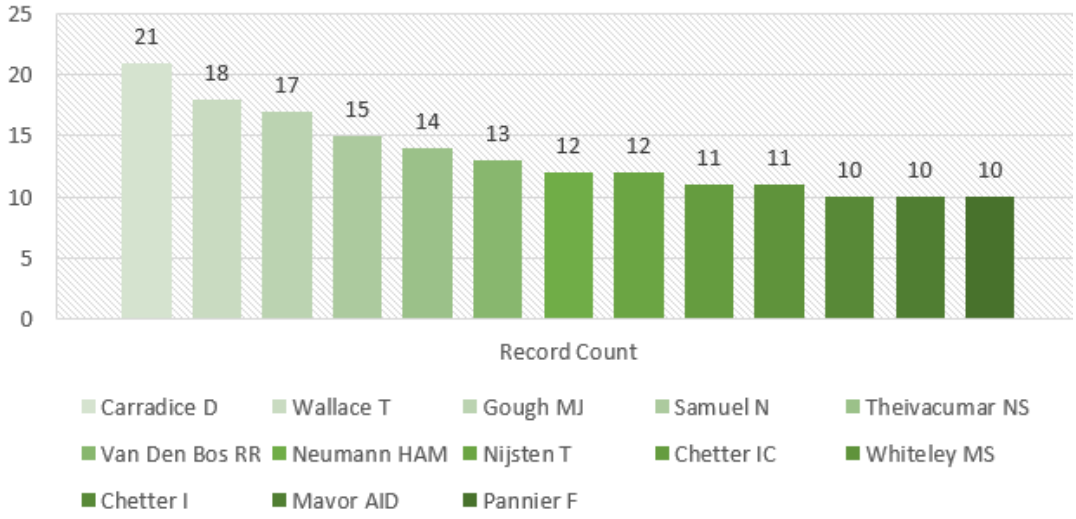

Figure 2. The authors with at least 10 publications on EVLA research.

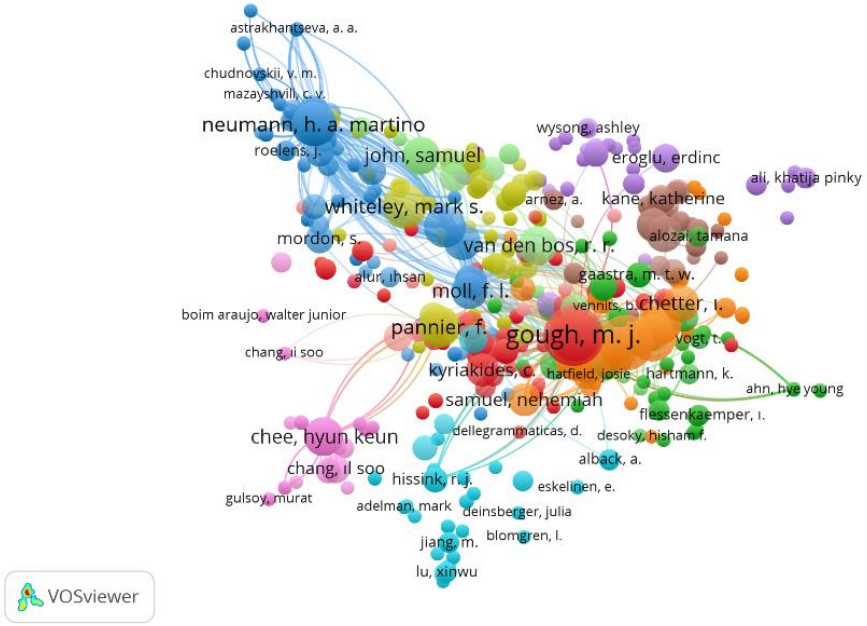

Figure 3. Citation analysis between top 100 authors.

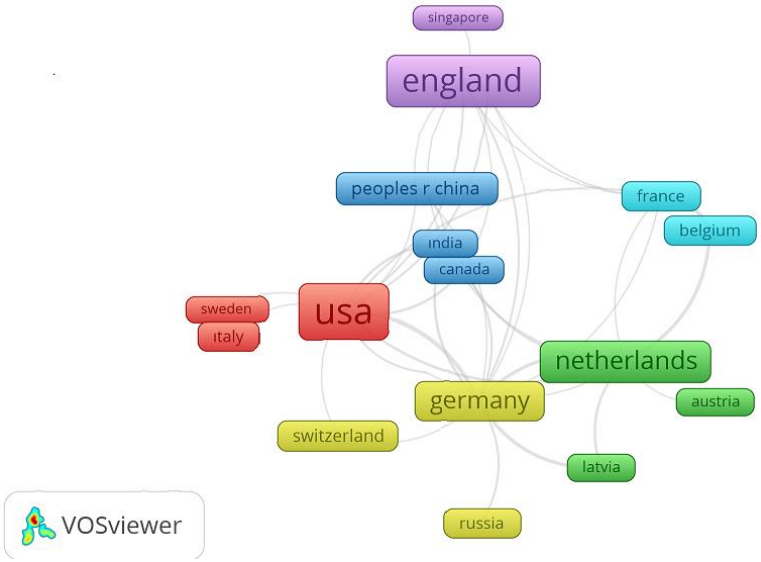

Figure 4. Co authorship analysis between countries.

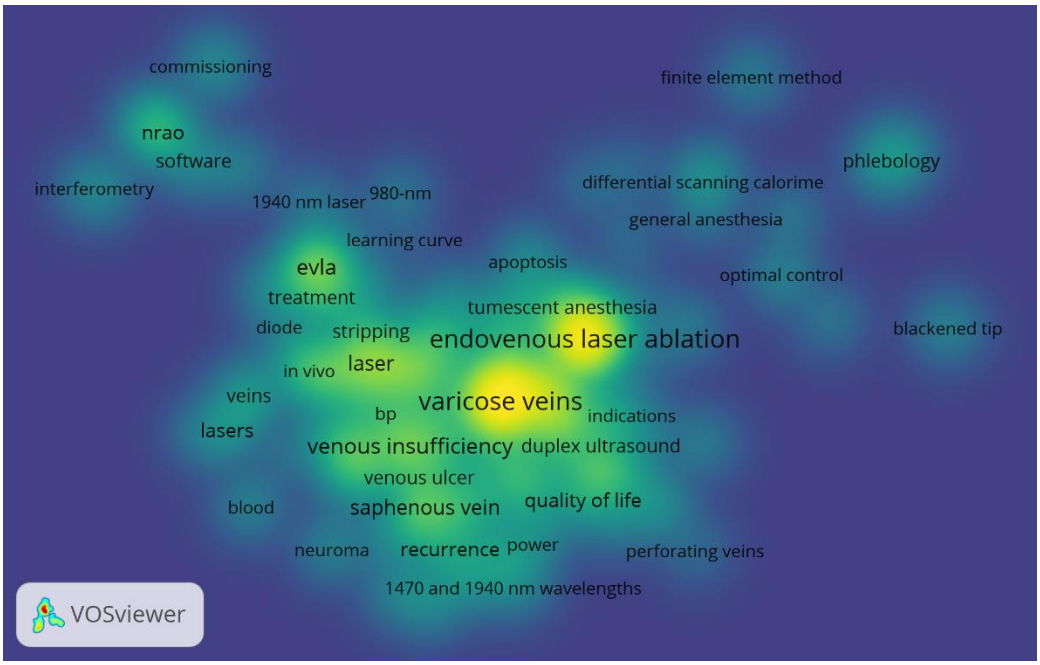

Figure 5. Density visulization of keywords.

4. Discussion

Leg varicosities can now be treated with EVLA, a popular minimally invasive treatment. It is an intriguing therapy from a clinical, scientific, and business perspective. Clinically, due to EVLA's very high success rate with few complications at all laser wavelengths, laser powers, and pullback velocities used, surgical stripping was replaced by EVLA (van den Bos et al., 2009). Independent of wavelength, energy dosage, follow-up time, and outcome criteria (occlusion/absence of reflux), a pooled analysis of EVLA in the Great Saphenous Vein revealed a 92% overall success rate (Malskat et al., 2019).

Even though similar bibliometric studies have been recently published both on cardiovascular disease and cardiovascular surgery (Huffman et al., 2013; O'Sullivan et al., 2015; Shuaib et al., 2015; Oo et al., 2020; Küçük et al., 2021; Zhang et al., 2022), no similar study was found on EVLA.

In this study, we looked over and evaluated the EVLA publications. We can comprehend the state of EVLA's development and research through bibliometric analysis, which also serves as a guide for future development and research focus. Even though the first study on EVLA was published in 1999 (Boné, 1999), in 2002, the first EVLA-related publication was published on the web of science. We can observe that the number of papers has increased significantly, despite the fact that EVLA is a new topic with few publications. As a result, this topic has drawn an increasing amount of attention and will probably continue to do so in the future. This is the first bibliometric study on EVLA research in the available literature.

Bibliometrics is a multidisciplinary discipline that uses mathematical and statistical techniques to quantitatively analyze all knowledge (Hu et al., 2020). With the help of bibliometric techniques, the most recent developments, hot topics, and geographic gaps in a given research discipline can be vividly depicted. This makes bibliometric techniques an important research tool for evaluating national and international research productivity, international cooperation, citation analysis, research trends, and the development of particular fields. Many bibliometric analysis techniques and tools, such as CiteSpace and VOSviewer, have been created recently to assist researchers in many fields in building knowledge maps, assessing the current level of knowledge about a topic, and locating research hotspots (Hu et al., 2020; Dindar Demiray et al., 2021; Öntürk et al., 2021; Durgun et al., 2022; Ekici et al., 2022; Özlü, 2022; Öztürk, 2022; Yıldız, 2022). In this study, the WOS database was used but no other tools were used to analyse the data. The number of documents and citations over the years, the most productive countries, affiliations, authors, the most published journals on EVLA research, and top cited articles were analyzed (Table 1-5, Figure 1,2).

46 countries contributed to the EVLA literature. Authors from the USA contributed 21.019 % of the articles on EVLA, considerably more than those from any other country, with England coming in second with 16.136 %, the Netherlands third with 10.191 %, and Türkiye fourth with 9.766 %. The USA is the global leader in EVLA research, which is consistent with its status as the industry leader in many other areas. Regrettably, there are still a lot of nations with an inadequate understanding of this topic and few study findings.

A citation count is one way to assess the significance of articles, but it is subject to bias. First, organizations with a greater volume of articles published could self-cite their own work. This phenomenon is explained by the preference for citing "local research" and the propensity

to incorporate research into clinical practice, both of which have been observed in other citation analyses (Ellul et al., 2017). The self-citation phenomenon may also be enhanced by restricting the search to English-language manuscripts only (Oo et al., 2020). In this study, the majority of the top-cited studies on EVLA were published in specialized journals for vascular surgery, and the highest number of citations was 389.

5. Conclusion

The current study is the first bibliometric study on EVLA. Despite the fact that the EVLA is a popular minimally invasive treatment in vascular surgery, it was found that the number of published documents was limited. And the participation was only from 46 countries.

Limitations

This research represents the first bibliometric evaluation of EVLA research trends using a single (WOS) database. This bibliometric study has certain limitations as well. The other electronic databases, like PubMed, Scopus, etc., are not searched or examined. The non-English papers were also excluded. The final drawback is that while some potentially influential articles were just published and may not be cited frequently, prominent publications were not cited frequently. The data for 2022 is also limited because the year has not yet come to an end, and it will be more accurate to analyze it after it has. Only the title section of the search engine was used during the search with selected keywords. There was a certain deviation from the research because these pertinent contents were not included. The number of citations for a given article may be influenced by a variety of factors, and they do not always accurately represent the article's academic significance.

Author Contributions

All tasks made by the single author of the manuscript and the percentage of the author contributions is present below. The author reviewed and approved final version of the manuscript.

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C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Approval/Informed Consent

The study complied with the Helsinki Declaration, which was revised in 2013. Ethics committee approval is not required as there is no human or animal research.

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