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ORIGINAL ARTICLE

Mapping the landscape of transplant research: A bibliometric study of Colombian centers (2013-2024)

Mapeo del panorama de la investigación en trasplantes: Un estudio bibliométrico de centros colombianos (2013-2024)

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Abstract

Introduction. Despite the critical importance of organ transplantation as a therapeutic strategy for end-stage organ failure, there is a lack of comprehensive understanding of the research landscape in this field in Colombia. This study aims to perform a bibliometric analysis of the literature on solid organ transplants published in Colombia.

Methods. A bibliometric analysis of transplant publications from Colombian centers between 2013 and 2024 was conducted, excluding conferences, abstracts and letters to the editor. Databases as PubMed, LILACS, Embase, and Scielo were accessed through a systematic review including the MeSH (Medical Subject Headings) term "transplant" and a Colombian affiliation was required. Two researchers independently reviewed the results. Variables such as authors' names, affiliations, journal impact factor, co-author count, and citation numbers were analyzed using descriptive statistics and the Bibliometrix R-package for quantitative and visual data.

Results. Search engines provided 1,898 articles, and only 292 met the inclusion criteria. Scientific production has increased, peaking in 2021 indicating a growing body of research. Key journals included Transplantation Proceedings and Biomedica. Prominent authors like Piñero F and Silva M had significant impact, and Brazil and Argentina were major collaborators. The main research themes were kidney and liver transplantation, with notable attention to donor selection in recent years.

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Conclusion. This bibliometric analysis provides insights into the state of transplant research in Colombia, aiming to enhance regional health outcomes through collaborative efforts. The study highlights the need for further research to address the identified gaps and challenges.

Keywords: transplantation; organ transplantation; kidney transplantation; liver transplantation; bibliometrics.

Resumen

Introducción. A pesar de la importancia del trasplante de órganos como tratamiento para la insuficiencia orgánica terminal, la investigación en este campo en Colombia no ha sido completamente explorada. El objetivo de este estudio fue realizar un análisis bibliométrico de la literatura sobre trasplantes de órganos sólidos publicada en Colombia.

Métodos. Se analizó la producción científica en trasplantes de centros colombianos entre 2013 y 2024, excluyendo conferencias, resúmenes y cartas al editor. Se utilizaron bases de datos como PubMed, LILACS, Embase y SciELO, con una búsqueda que incluyó el término MeSH *transplant* y se exigió una afiliación colombiana. Dos investigadores revisaron los resultados de forma independiente. Se analizaron variables como nombres de autores, afiliaciones, factor de impacto de revistas, número de coautores y citas, utilizando estadísticas descriptivas y el paquete R Bibliometrix.

Resultados. Se encontraron 1898 artículos, de los cuales 292 cumplieron con los criterios de inclusión. La producción científica mostró un aumento, alcanzando su pico en 2021, lo que sugiere un crecimiento en la investigación. Las revistas más relevantes incluyeron Transplantation Proceedings y Biomédica. Autores como Piñero F y Silva M tuvieron un impacto significativo, y Brasil y Argentina fueron los principales colaboradores. Los temas principales fueron el trasplante renal y hepático, con mayor atención a la selección de donantes en años recientes.

Conclusión. Este análisis bibliométrico proporciona una visión del estado de la investigación en trasplantes en Colombia y resalta la necesidad de más estudios para abordar las brechas identificadas y mejorar los resultados en salud regional.

Palabras clave: trasplante; trasplante de órganos; trasplante renal; trasplante hepático; bibliometría.

Introduction

Organ transplantation is a leading therapeutic strategy for end-stage organ failure, enhancing survival rates, quality of life, and public health, while reducing socioeconomic burden [1,2]. The field has globally advanced with the development of innovative techniques and improved success rates due to ongoing research [3,4].

In the Latin American region, health outcomes have seen a positive impact due to the advancements in the field of solid organ transplants [5,6]. Among these countries, Colombia has experienced significant development in this landscape over the past decades [7,8]. Current data shows an increase in annual transplants, particularly kidney and liver transplants [9,10]. However, persistent challenges include the need for a mandatory transplant database, increased donor identification, and governmental support to optimize quality and increase transplant rates [8,11]. A collaborative approach, engaging multiple stakeholders across the healthcare sector is required to address these issues [5,8].

Scientific research and publications are essential for organ transplantation advancement [12]. They serve as a record of knowledge and progress, guiding clinical practice, informing health policies, and encouraging innovation [13]. Collaborative research efforts across Colombian centers are essential for progress and addressing transplantation challenges. In this context, bibliometric analysis is a useful approach for evaluating scientific output, providing insights into research development, and impact [14]. This study aims to perform a bibliometric analysis of the literature on solid organ transplants published in Colombia.

Methods

Study Design

This study conducted a bibliometric analysis of the past decade's literature (2013-2024), focusing on transplant-related publications from researchers affiliated with Colombian institutions until January 23, 2024. The search strategy included engines such as Pubmed, LILACS, Embase, and Scielo, using the Medical Subject Headings (MeSH) term *transplants*. Additionally, each researcher's profile must have indicated an affiliation with at least one Colombian institution, guaranteeing its participation in the country.

Inclusion and Exclusion Criteria

Articles published between 2013 and 2024 were considered, encompassing all types of publications except for conference abstracts and letters to the editor. The study was confined to human research, excluding animal models. All organ transplantation-related topics were included. Additionally, the publications were published in national or international journals. Articles were evaluated through title, abstract, and full-text examination in the present study. Two researchers independently conducted the primary data selection and discussed any potential differences.

Variables and Outcomes

The analysis included: authors' names, affiliations of the authors, corresponding author's name, corresponding author's affiliation, title, journal, quartile, Scimago impact factor of the publication year, number of co-authors, country, language, article type, keywords, MeSH terms, year of publication, total citations count. Some of these variables were obtained through automatic software extraction and others were filled out manually by the research team.

Statistical Analysis

Descriptive statistics were employed to report demographic characteristics: frequencies and percentages for categorical variables and means and standard deviations for numerical variables. An analysis focused on the ten most relevant authors, institutions and countries was included. Additionally, the Bibliometrix R-package was used for obtaining some variables data, conducting quantitative analysis in bibliometrics and scientometrics and generating graphical resources [15].

Results

Included studies

In the initial phase of the study, search engines provided 1,898 articles, which were reduced to 1,673 after removing duplicates. After further scrutiny of titles, abstracts, and full texts, only 292 met the inclusion criteria. Figure 1 categorizes the annual count of publications by year of publication, showing an increase until 2021, followed by a decrease in transplant-related articles. The year 2021 marked the peak with 47 publications, of which 25 had a female as the first or last author. Over recent years, the gender distribution among first and last authors has been moving towards a more balanced ratio.

Distribution of top countries, institutions, and journals in solid organ transplantation research

Table 1 presents the distribution of publications across top countries, institutions, and journals from 2013 to 2024, along with the number of citations, average citations, and their proportion relative to the total citations and publications. Each table is sorted in descending order of the number of publications. From 2013 to 2024, Colombia dominated the publication landscape in solid organ transplantation research, contributing 57.1% of the total publications. Germany, Argentina, and USA followed with 8.4%, 8.4%, and 6.5% contributions, respectively. Fundación Valle de Lili led the institutional contributions with 14.7% of the total publications, closely followed by Universidad de Antioquia and Universidad Nacional de Colombia, each contributing 8.2%. Transplantation Proceedings emerged as the leading journal with 9.2% of the total publications, followed by Biomédica 6.5% and Revista Colombiana de Cirugía 5.4%.

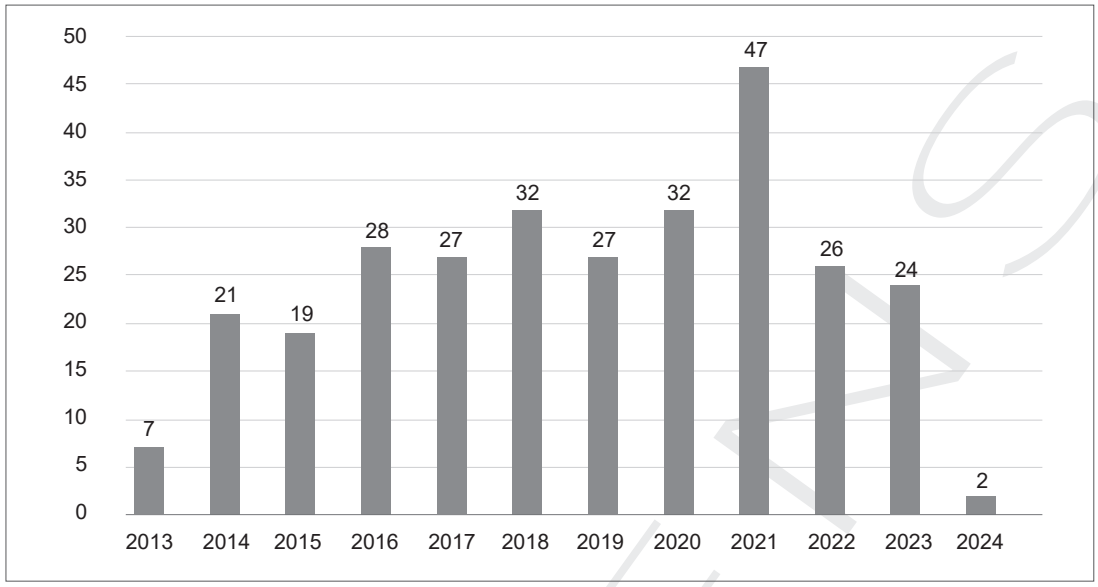


Figure 1. Number of publications by year.
Source: Prepared by the authors.

Author contributions

Figure 2A presents an analysis of the contributions of various authors in organ transplantation research in Colombia from 2013 to 2024. Remarkably, Piñero F, Silva M, Poniachik J, and Marciano S stood out with the highest Total Citations per Year (TCpY) value of 10.1 in 2016. Between 2016 and 2017, Caicedo LA, Echeverri GJ, and Villegas JI emerged as the most prolific contributors. The trend shifted in 2020, with Piñero F, Silva M, Poniachik J, and Marciano S seeing a surge in the number of publications. Additionally, Giron-Luque F, a recent entrant, also made a notable contribution despite a lower citation count.

Country collaboration

Figure 2B provides an overview of the scientific production in organ transplantation research, with Colombia being the common country across all research. It lists the main collaborating countries and the number of publications they have contributed. Brazil has the most publications with 35, followed by Argentina (34), Chile and Spain (23 each), Mexico (19), Germany (18), USA (16), Italy (13), and Peru (12).

Essential keywords

Figure 3A illustrates a network of distinct clusters, each differentiated by a unique color. These clusters represent the most frequently used concepts in Colombian medical research, derived from an analysis of 292 articles. Notably, "kidney transplant" and "liver transplant" emerge as the most significant concepts, with 94 and 54 occurrences, respectively.

Figure 3B provides an overview of the most prevalent themes in the last seven years. "Kidney transplantation" emerges as the most frequent theme, representing an occurrence close to 100, followed by "liver transplantation" with over 50 occurrences. Other themes include graft survival, graft rejection, risk factors, and treatment outcomes.

It is worth noting that "donor selection" has gained relevance in clinical research in the last three years.

Table 2 highlights 11 studies in solid organ transplantation, with the three most cited being those led by Rincon-Arevalo (2021), Di Pasquale (2019), and Floreani (2018), which have accumulated 245, 153, and 142 citations, respectively.These findings underscore the diversity of

Table 1. Scientific production in organ transplantation: Top countries (by citations), institutions, and journals (by publications), 2013–2024.

Distribution of top-performing countries, institutions, and journals in the field during the study period.

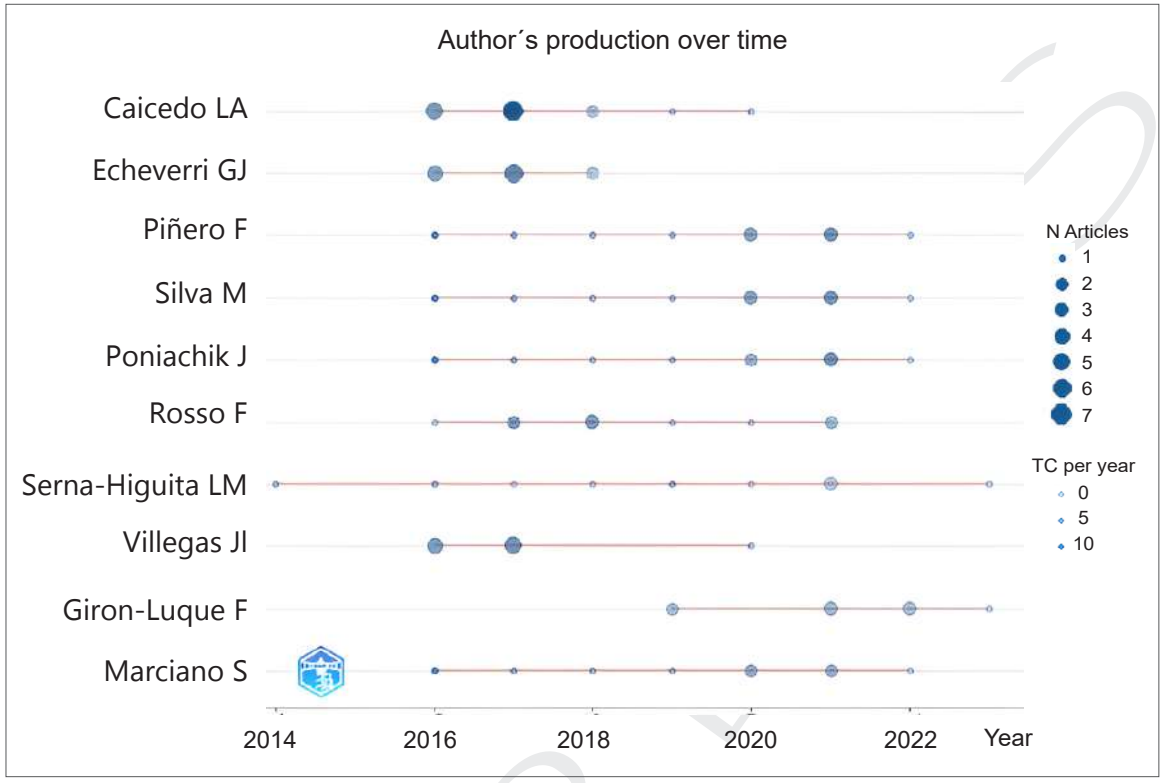
No.	Country	Total citations	Average Article Citations	Proportion of total citations against total (%)
1	Colombia	2129	9.2	57.1
2	Germany	315	45	8.4
3	Argentina	313	26.1	8.4
4	USA	242	20.2	6.5
5	Italy	153	153	4,1
6	Brazil	110	13.8	2.9
7	Belgium	103	34.3	2.7
8	Switzerland	95	47.5	2.5
9	Mexico	75	75	2
10	Iran	63	63	1.6
Total		3598	45.05 (mean)	96.60%

No.	Institution	Number of publications	Proportion of related pub. against 188 (%)	Proportion of related pub. against total (%)
1	Fundación Valle de Lili	43	22.9	14.7
2	Universidad de Antioquia	24	12.8	8.2
3	Universidad Nacional de Colombia	24	12.8	8.2
4	Colombiana de Trasplantes	22	11.7	7.5
5	Hospital Pablo Tobón Uribe	21	11.2	7.1
6	Fundación Cardio-Infantil	15	7.9	5.1
7	Instituto Nacional de Salud	11	5.8	3.7
8	Clínica Imbanaco	10	5.3	3.4
9	Fundación Santa Fe de Bogotá	9	4.7	3.1
10	Hospital San Ignacio	9	4.7	3.1
Total		188	100	64.4

No.	Journal	Number of publications	Proportion of related pub. against 116 (%)	Proportion of related pub. against total (%)
1	Transplantation Proceedings	27	23.2	9.2
2	Biomédica	19	16.4	6.5
3	Revista Colombiana de Cirugía	16	13.8	5.4
4	Transplant Infectious Disease	10	8.6	3.4
5	Revista Urología Colombiana	9	7.7	3.1
6	Transplantation	8	6.9	2.7
7	Nefrología	6	5.1	2
8	Revista Colombiana de Gastroenterología	6	5.1	2
9	Colombia Médica	5	4.3	1.7
10	Liver International	5	4.3	1.7
11	The Journal of Heart and Lung Transplantation	5	4.3	1.7
Total		116	100	39.7

Source: Prepared by the authors

A



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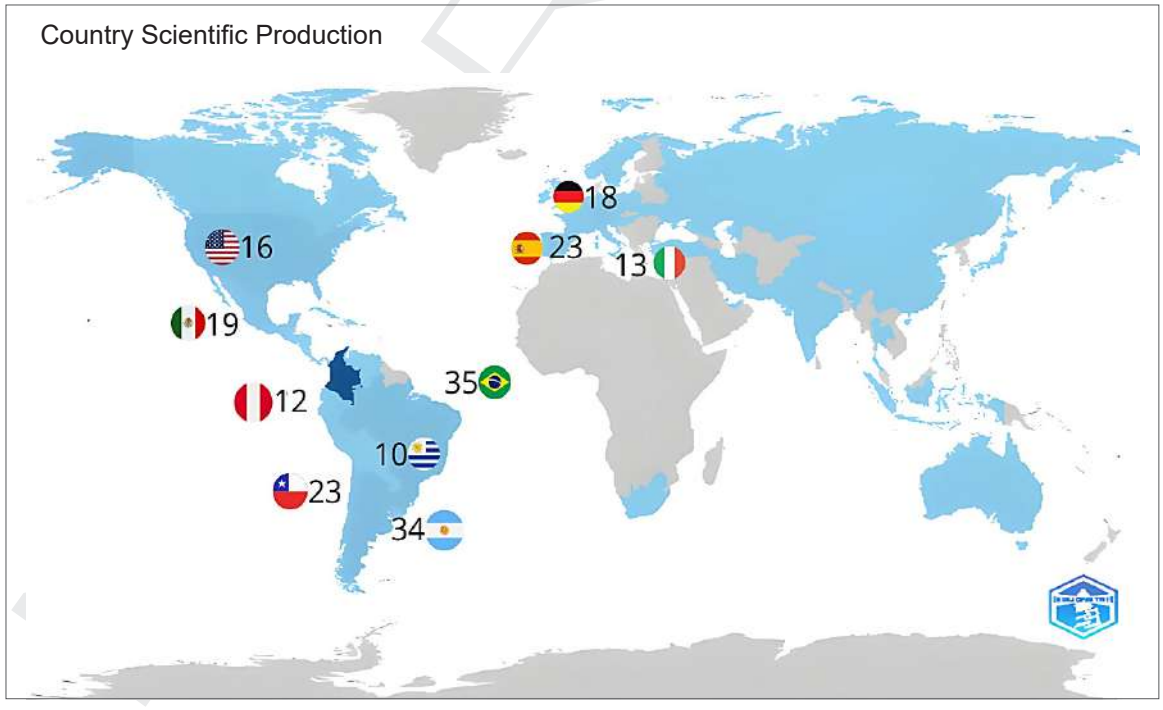
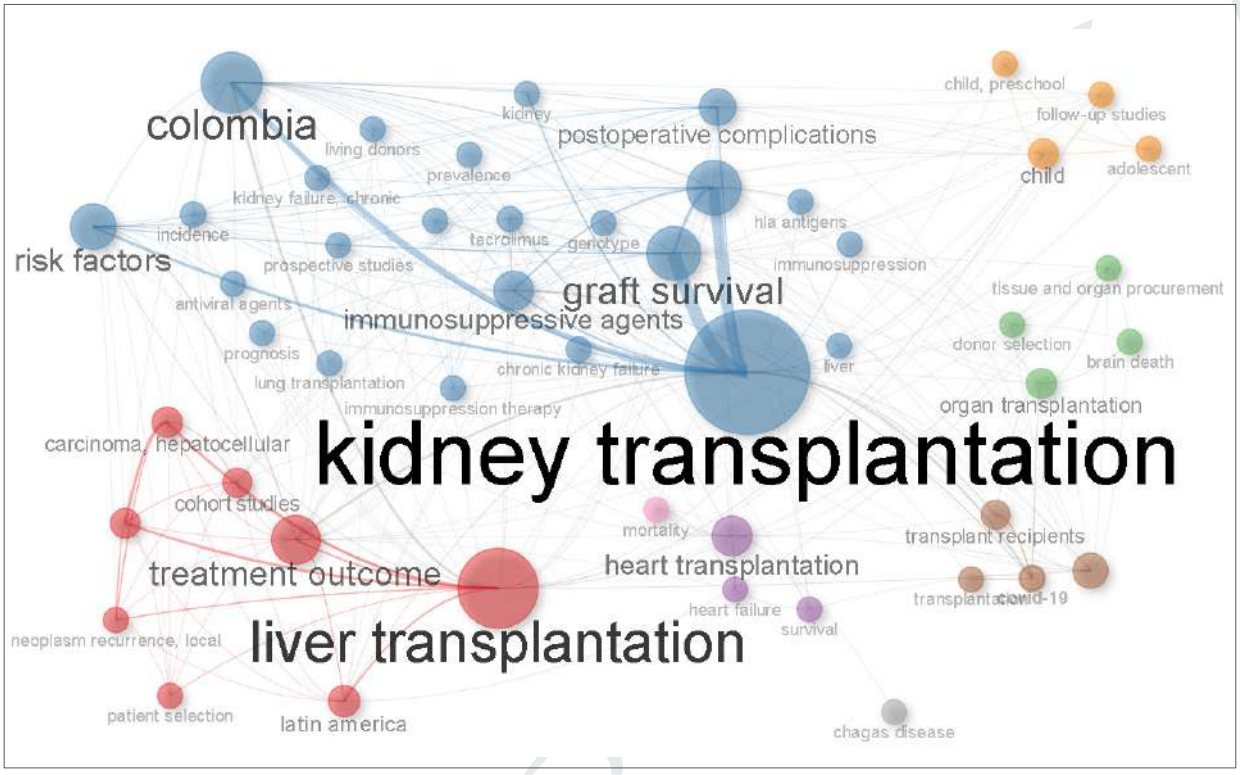


Figure 2A. Trajectory of the Top 10 Authors in Scientific Production on Organ Transplantation in Colombia Over the Years (2013-2024). **Figure 2B.** Contribution of the Top 10 Countries to the Production of Scientific Studies on Solid Organ Transplantation.

Source: Prepared by the authors using the Bibliometrix package in R."

A



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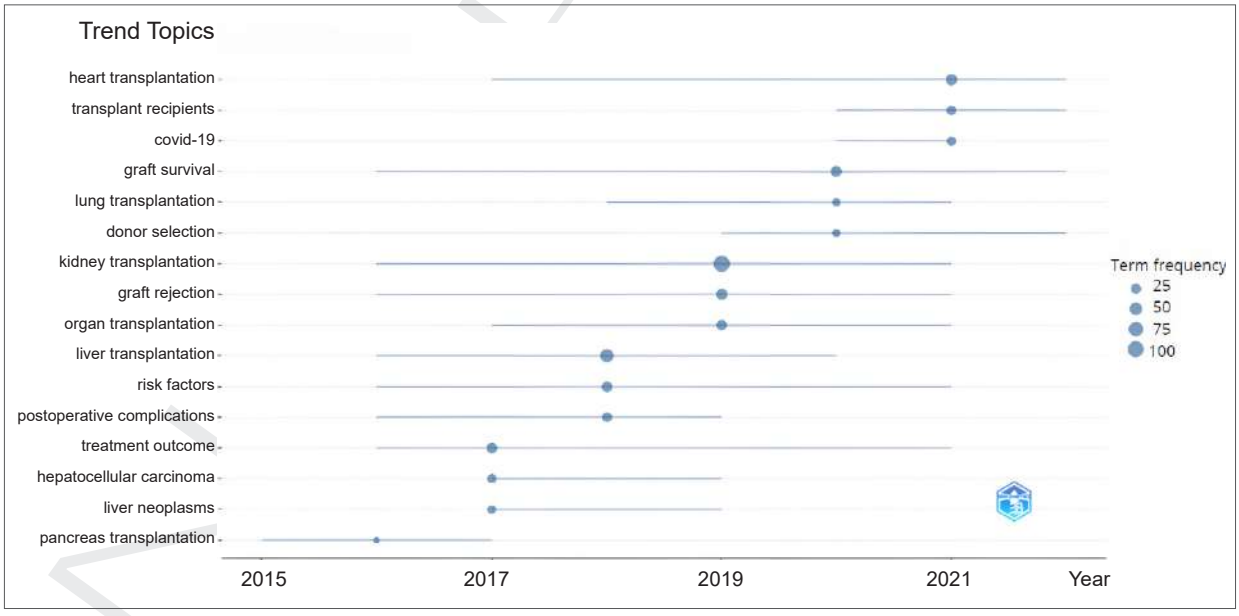

Figure 3A. Displays the network of connections between keywords in the field of clinical research on solid organ transplantation between 2015 and 2021, while **Figure 3B** specifically highlights the keywords themselves and their frequency of occurrence during the same period.

Source: Prepared by the authors using the Bibliometrix package in R.

approaches and the variety of publication types, ranging from cohort studies to reviews, which characterize the academic landscape of this field.

Discussion

This is the first bibliometric analysis of organ transplantation literature in Colombia during the last ten years (2013-2024). Out of 1898 articles, only 292 met the inclusion criteria. The analysis revealed a growing trend by influential authors, especially until 2020. Fundación Valle de Lili had the highest number of articles, and Transplantation Proceedings was the most prolific journal. Brazil and Argentina were the top international collaborators with Colombia. The most common keywords were "kidney transplantation," "liver transplantation," and "graft rejection".

The volume of transplant literature has significantly expanded in recent years [12]. In 2013, only six articles were published on the topic, whereas by 2023, this number had grown to 34. Notably, 2018 and 2021 were the years with the highest scientific output. However, a recent decline in publications is likely due to the COVID-19 pandemic's disruption of academia [16]. The most influential authors in the field, Caicedo LA, Echeverri GJ, and Piñero F have made substantial contributions with 16, 12, and 11 primary author publications,

Table 2. Top cited studies in solid organ transplantation and assessment of publication impact (2013-2024).

n	Title	Author	Year	Journal	Quartile	Pub. Type	Citations	Co-authors
1	Impaired humoral immunity to SARS-CoV-2 BNT162b2 vaccine in kidney transplant recipients and dialysis patients	Rincon-Arevalo	2021	Science Immunology	Q1	Cohort study	245	25
2	Prevalence and etiology of community-acquired pneumonia in immunocompromised patients	Di Pasquale	2019	Clinical Infectious Diseases	Q1	Cross-sectional study	153	11
3	Etiopathogenesis of autoimmune hepatitis	Floreani	2018	Journal of Autoimmunity	Q1	Review	142	9
4	Amphotericin B deoxycholate versus liposomal amphotericin B: effects on kidney function	Botero Aguirre	2015	The Cochrane Database of Systematic Reviews	Q1	Systematic review and meta-analysis	110	2
5	Renal replacement therapy in Latin American end-stage renal disease	Rosa-Diez	2014	Clinical Kidney Journal	Q3	Cross-sectional study	98	26
6	Liver transplantation for hepatocellular carcinoma: evaluation of the alpha-fetoprotein model in a multicenter cohort from Latin America	Piñero	2016	Liver international	Q1	Cohort study	91	22
7	Post-liver transplantation Diabetes Mellitus: A review of relevance and approach to treatment	Pelaez-Jaramillo	2018	Diabetes Therapy	Q1	Review	90	4
8	Allocation of liver grafts worldwide - Is there a best system?	Tschuor	2019	Journal of Hepatology	Q1	Cross-sectional study	85	6
9	Cost-effectiveness of kidney transplantation compared with chronic dialysis in end-stage renal disease	Rosselli	2015	Saudi Journal of Kidney Diseases and Transplantation	Q3	Economic evaluation study	82	3
10	Hepatocellular carcinoma in South America: Evaluation of risk factors, demographics, and therapy	Debes	2018	Liver international	Q1	Cross-sectional study	75	23
11	Actitudes y creencias sobre la donación de órganos en Colombia: ¿dónde se deben enfocar los esfuerzos para mejorar las tasas nacionales de donación?	Castañeda	2014	Revista de la Facultad de Medicina	Q4	Cross-sectional study	75	11

Source: Prepared by the authors.

respectively. This reflects the consistent effort of various organ transplant and donation teams to generate evidence in the country in diverse populations [17].

It is noteworthy that the productivity of influential authors has varied over time. Researchers such as Serna-Higuita LM, Piñero F, and Marciano S have maintained consistent productivity throughout the years. In contrast, other authors like Echeverri GJ, Villegas JI, and more recently, Giron-Luque F, have had higher publication rates during shorter periods. Despite the decades-long history of organ transplantation, the recent engagement in research reflects a dynamic shift in involvement among researchers and institutions [18]. The analysis highlighted that Brazil and Argentina were the most frequently collaborating countries in the field, indicating a strong international partnership in organ transplantation research [19-24]. Although international collaboration is relevant, we observe a growing trend towards regional cooperation, particularly within Latin America, alongside active engagement from leading transplant and donation nations like Spain and the United States [25-29].

In terms of citation impact, authors such as Piñero F, Silva M, Poniachik J, and Marciano S achieved the highest TCpY and the largest number of publications between 2020 and 2021. Regarding institutional productivity, Fundación Valle de Lili emerged as the leading institution with 43 publications, followed by the Universidad de Antioquia and the Universidad Nacional de Colombia, each contributing 24 publications. However, a gap was identified in co-authorship collaboration networks between authors from different institutions, suggesting a need for stronger inter-institutional collaboration. The limited collaboration between institutions, therefore, may impede progress in organ transplantation in Colombia. Thus, strengthening partnerships among Colombian research teams is crucial, as it allows for sharing knowledge, fostering innovation, and enhancing transplant outcomes. Moreover, greater collaboration could result in more comprehensive studies, improved patient care, and better health policies, ultimately contributing to the overall success of organ transplantation efforts across the country [30]. As shown in figure 2, the publications are numerous within each research team. However, collaborative work between different institutions must be strengthened, which is consistent with other studies carried out previously [13].

The distribution of top-tier journals is led by Transplantation Proceedings, followed by Biomédica, and Revista Colombiana de Cirugía. The notable presence of Biomédica and Revista Colombiana de Cirugía, with 19 and 16 publications respectively, indicate diverse research interests spanning biomedical science and clinical surgery. This pattern emphasizes the critical role of regional journals in Latin America and open access for disseminating local research findings. Additionally, the concentration of publications in these specific journals suggests robust collaborative networks and institutional affiliations, reflecting a mature and specialized field with well-established niches in transplantation research and clinical practice [31-33].

Additionally, the frequent use of the keywords "kidney transplantation," "liver transplantation," and "graft rejection" indicates the primary research focus within the field of organ transplantation in Colombia. This focus could be due to the high prevalence of kidney and liver diseases in Colombia, driving research efforts to address these public health concerns [5,6], availability of funding, advanced medical infrastructure, and the concentration of clinical expertise and specialized centers. Lastly, the focus on "graft rejection" aligns with global research trends, suggesting that Colombian researchers contribute to international efforts to improve transplantation outcomes [34,35].

Also, the significant growth in transplant-related research in Colombia has direct implications for clinical practice. The increased focus on kidney and liver transplantation provides valuable evidence to inform clinical guidelines, particularly in optimizing immunosuppressive regimens and standardizing donor selection criteria [31]. Advances in donor characterization, a key area of recent research, can lead to improved graft survival

and reduced postoperative complications [36]. As research continues to expand, it will empower clinicians to make more informed, evidence-based decisions, ultimately improving outcomes for transplant recipients with complex conditions [33,37].

Despite significant regional collaboration, intra-country collaboration among Colombian research teams is crucial [21,28]. While regional collaboration enhances the breadth and diversity of research endeavors, fostering intra-country collaboration strengthens local expertise, promotes knowledge exchange, and facilitates the development of tailored solutions to country-specific challenges [13,38]. By pooling resources, sharing expertise, and fostering interdisciplinary collaboration among Colombian research teams, synergistic efforts can accelerate scientific progress, enhance the quality of research outputs, and ultimately contribute to advancements in organ transplantation research with direct relevance to the Colombian context.

Strengths and Limitations

This study, being the first comprehensive bibliometric analysis of organ transplantation literature in Colombia, provides valuable insights into publication trends and key authors. Utilizing Bibliometrix, we conducted detailed analysis, including collaboration networks and the identification of important nodes using standardized measurements and variables. This facilitates the comparison with prior research that utilized a comparable methodology [15]. However, there are several limitations that should be acknowledged. First, there may be potential selection biases in the inclusion of articles, as the search strategy may have led to the exclusion of relevant studies. Second, the analysis relies heavily on citation-based metrics, which have inherent limitations in accurately capturing the quality and true impact of research. Citation counts can be influenced by various factors, including journal visibility, author networks, and publication language, rather than purely reflecting the scientific contribution of the work. Finally, bibliometric analyses are inherently dependent on the selected databases, which may not cover all relevant publications comprehensively, potentially leading to incomplete or biased findings.

Conclusion

This study conducts a comprehensive bibliometric examination of solid-organ transplantation research in Colombia from 2013 to 2024. It identifies key contributors and prevalent research themes. The study emphasizes the role of collaboration in enhancing research output and addressing health issues. In particular, the growing relevance of donor selection in clinical research over the past three years should be a focus moving forward, as it reflects the shift towards optimizing transplant outcomes. The findings are expected to boost scientific productivity, promote a collaborative research culture, improve clinical practices, and inform health policies. These efforts aim to provide a clear picture of organ transplant research in Colombia and the wider Latin American region. This understanding can guide future research and policymaking.

Compliance with ethical standards

Informed consent: This review strictly adheres to ethical standards in handling published data, ensuring proper attribution to all sources and avoiding the misuse of proprietary information. We declare that, in accordance with the principles established in the Declaration of Helsinki and Resolution 008430 of October 4, 1993, of the Ministry of Health, and given that this research was classified as low risk, this study was conducted in compliance with the established ethical guidelines. Consequently, the journal Revista Colombiana de Cirugía is exempt from any responsibility for the dissemination of the results presented in this article.

Conflicts of interest: The authors declare no conflicts of interest.

Use of Artificial Intelligence: It is worth noting that no AI-assisted technologies were used in any aspect of the study. All procedures, from data collection to analysis and discussion, were carried out manually by the research team.

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Author's contribution

- Conception and design of the study: Fernando Girón-Luque, Andrea Gomez-Montero, Nicolás Lozano-Suárez, Andrea Garcia-López.
- Acquisition of data: Andrea Gomez-Montero, Marianella Ibarra-Padilla, Maritza Jiménez-Gómez, Nicolás Lozano-Suárez, Andrea Garcia-López.
- Data analysis and interpretation: Fernando Girón-Luque, Andrea Gomez-Montero, Marianella Ibarra-Padilla, Maritza Jiménez-Gómez, Santiago Cabas, Andrea Garcia-López.
- Drafting the manuscript: Andrea Gomez-Montero, Maritza Jiménez-Gómez, Santiago Cabas.
- Critical review and final approval: Fernando Girón-Luque, Andrea Gomez-Montero, Marianella Ibarra-Padilla, Maritza Jiménez-Gómez, Santiago Cabas, Nicolás Lozano-Suárez, Andrea Garcia-López.

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